

# **VOLVO**

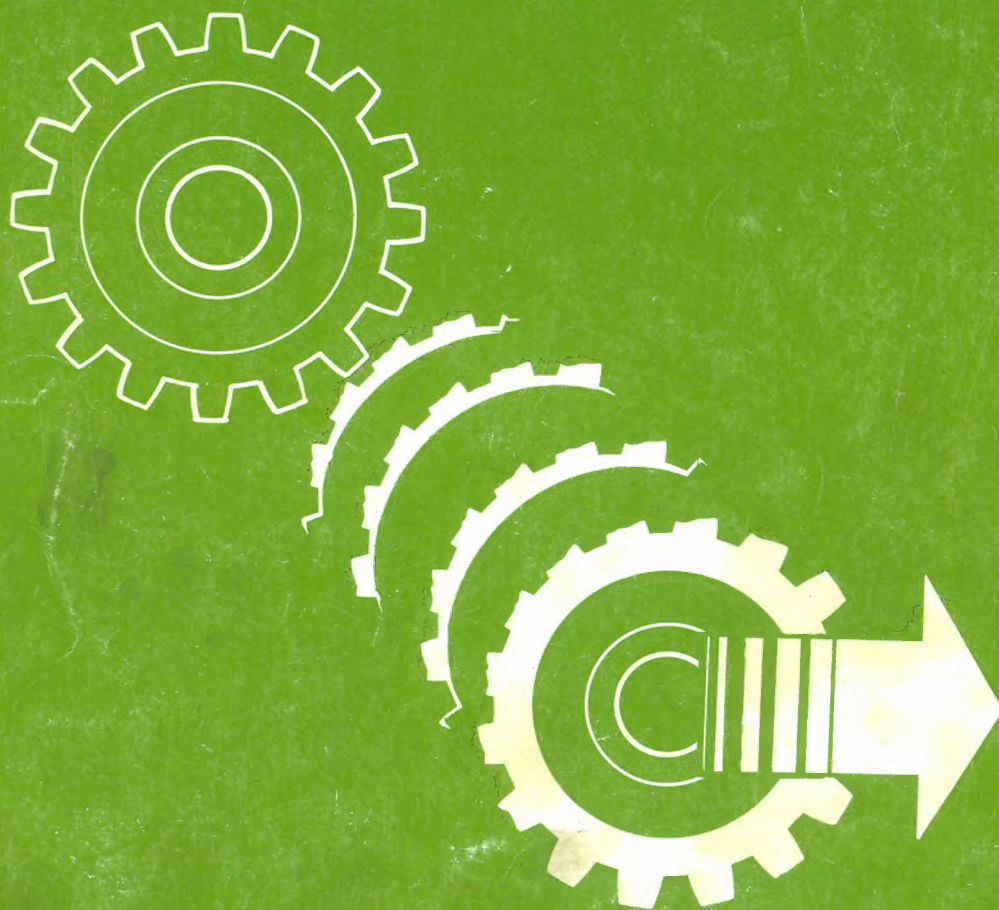
## **Service Manual**

### **Reconditioning**

**Section 4 (43)**

**Manual transmissions  
M 46, M 47, M 47 II  
including types J & P  
Overdrives**

**700**



**Volvo Car Corporation**



1. 2. 3. 4. 5.  
6. 7. 8. 9. 10.



Volume 1st Edition

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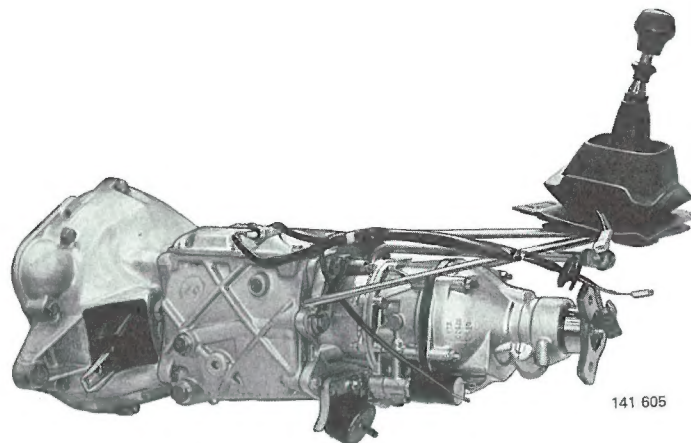
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**Order number TP 30941/1**

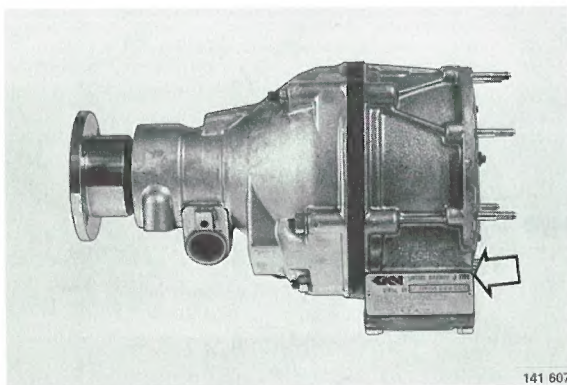
We reserve the right to make alteration without prior notification

## Foreword

### M 46 Transmission

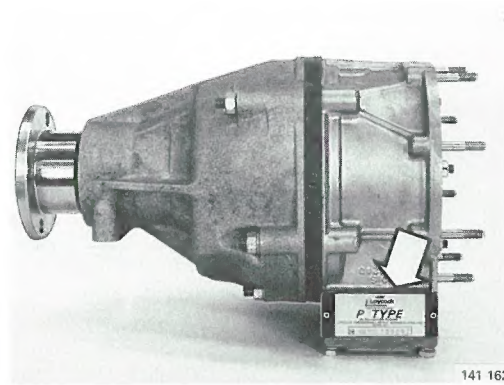


Four-speed transmission with electrically-operated overdrive. Transmission housing of cast iron or aluminium. There are two types of overdrive, Type J and Type P.



#### Type J

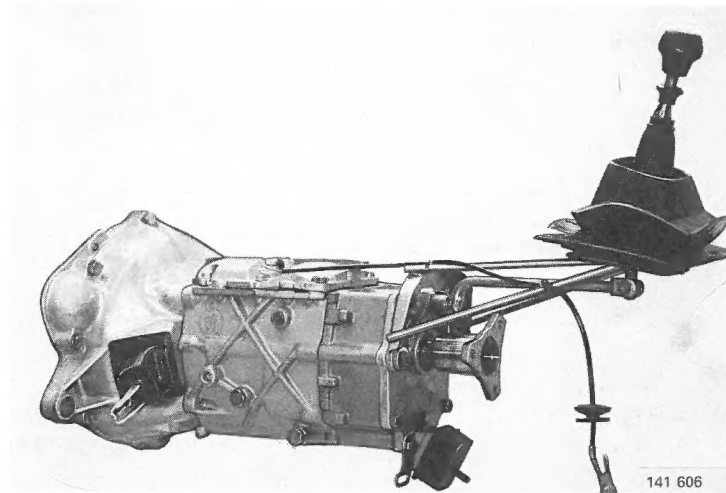
Overdrive is engaged by a solenoid which changes the oil flow direction. The gear ratio is changed by a planetary gear.



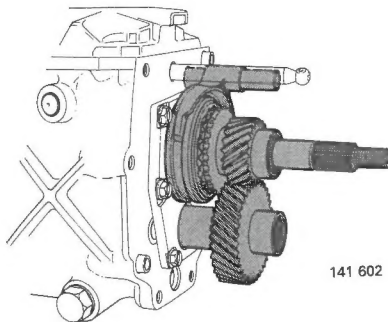
#### Type P

Stronger than Type J and is used in combination with high-torque engines. Has no connection for speedometer cable.

## M 47/M 47 II Transmissions

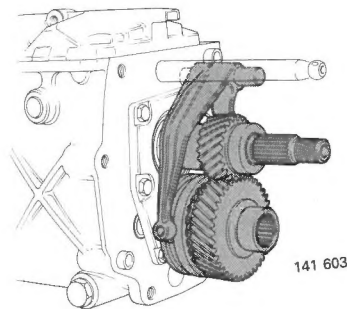


Five-speed transmission with the fifth gear assembly located in the rear extension. From 1986, the fifth gear synchronizer and gear wheel are located on the countershaft (previously on the main shaft). Hence the designation M 47 II. Both types have aluminium housings.



### M 47

An additional shaft incorporating a shift fork engages/disengages the fifth gear. The fifth gear synchronizer and gear wheel are located on the main shaft.



### M 47 II

The fifth gear shift fork is extended to reach the synchronizer and gear wheel on the countershaft.

## Specifications

### Reduction ratios

	M 46	M 47/M 47 II
1st gear .....	4.03:1	4.03:1
2nd gear .....	2.16:1	2.16:1
3rd gear .....	1.37:1	1.37:1
4th gear .....	1:1	1:1
Overdrive (5th gear on M 47/M 47 II) .....	0.79:1	0.83:1 (M 47 II: 0.82:1)
Reverse .....	3.68:1	3.68:1

### Clearances

Reverse gear to shift fork .....	0.1–1.0 mm 0.004–0.04 in	0.1–1.0 mm 0.004–0.04 in
End float: input shaft .....	0.01–0.20 mm 0.0004–0.008 in	0.01–0.20 mm 0.0004–0.008 in 0.01–0.10 mm
countershaft .....	clearance 0.03 mm (0.0012 in) for pre- tension 0.05 mm (0.002 in)	
main shaft .....	0.01–0.20 mm (0.0004–0.008 in)	0.01–0.20 mm (0.0004–0.008 in)
5th gear synchronizer hub .....		0.01–0.20 mm (M47 only) (0.0004–0.008 in)

### Overdrive oil pressures

4th gear .....	approx 0.15 MPa (21 psi)
----------------	--------------------------

#### Overdrive engaged

D 24 T, with asbestos-free friction linings .....	2.8–3.1 MPa (400–440 psi)
Gasoline turbo with asbestos-free friction linings .....	< 3.4 MPa (485 psi)
Gasoline turbo with old type friction linings .....	3.9–4.2 MPa (555–600 psi)
Remaining, with old type friction linings .....	3.7–4.0 MPa (525–570 psi)

#### Type P

All .....	2.8–3.1 MPa (400–440 psi)
-----------	---------------------------

### Lubricant

Type .....	*ATF type F or G
Oil capacity, M 46 .....	2.3 litre (2.4 US qt)
M 47 .....	1.3 litre (1.35 US qt)

\* In case of complaints use Volvo Thermal Oil, P/N 1161243-3.  
Volvo Thermal Oil should only be used for vehicles driven in areas where the temperature seldom drops below  $-10^{\circ}\text{C}$  ( $14^{\circ}\text{F}$ ) or for high-mileage vehicles such as Taxis.



**Tightening torques**

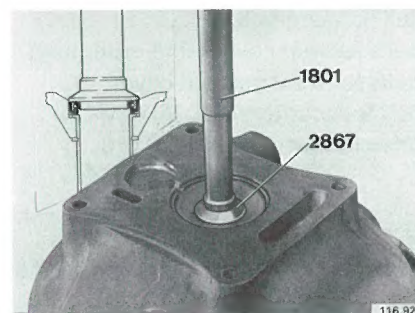
	Nm	ft lb
Bell housing bolts	35–50	25–35
Bolts for rear cover (shift assembly)	35–50	25–35
Bolts for transmission cover	15–25	10–20
Bolt for countershaft, M 47/M47 II	35–45	25–30
Drive flange nuts, M 47, M 16	70–90	50–65
M 20	90–110	65–80
M 46	165–180	120–135
Nut for rear housing M 46	12–18	9–13
Nut for 5th gear synchronizer, M 47 II	120	90

**Overdrive**

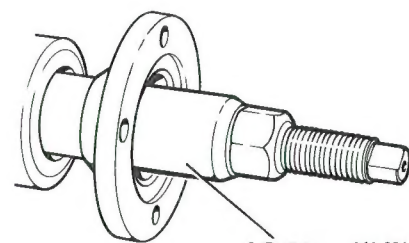
Plug for relief valve	22	16
Plug for filter	22	16
Plug for check valve	22	16
Oil pan bolts	10	7
Nuts on stud bolts, front housing	12	9
rear housing	12	9
Solenoid valve (solenoid)	50	40
Nuts for bearing holder	10	7
Plug, oil pressure gauge connection	15	11

## Special tools

999	Description — use
1801-3	<b>Standard handle:</b> installing clutch housing seal
1845-0	<b>Press tool:</b> installing drive flange
2412-8	<b>Drift:</b> installing seal, bearing, output shaft in overdrive
2413-6	<b>Drift:</b> installing front bearing on M 47
2520-8	<b>Stand:</b> for fixture 5130
2709-7	<b>Puller:</b> removing overdrive
2806-1	<b>Drift:</b> installing bearing in holder for clutch unit
2834-3	<b>Gauge:</b> oil pressure
2835-0	<b>Centering shaft:</b> for planetary gear to output shaft
2836-8	<b>Plug wrench:</b> for plugs
2852-5	<b>Support:</b> installing synchronizer hub
2853-3	<b>Support:</b> removing synchronizer hub
2867-3	<b>Drift:</b> installing clutch housing seal
2985-3	<b>Wrench:</b> removing main shaft bearing
2986-1	<b>Drift:</b> installing countershaft bearing
5058-6	<b>Puller:</b> removing main shaft bearing
5064-4	<b>Drift:</b> installing seal in rear housing
5069-3	<b>Puller:</b> seal
5090-9	<b>Tube:</b> installing damper
5096-6	<b>Spacer:</b> 5th gear housing (B 28 tool, 4 pcs)
5103-0	<b>Drift:</b> removing bearing in holder for clutch unit
5130-3	<b>Fixture:</b> used with stand 2520 or 5154
5131-1	<b>Puller:</b> removing countershaft bearings
5154-7	<b>Puller bolt:</b> for 5058

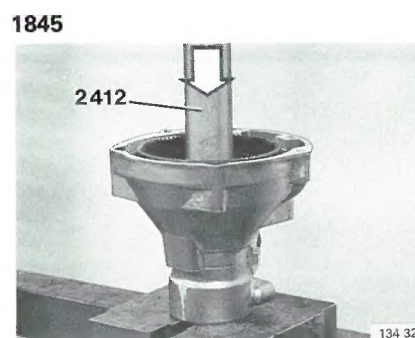


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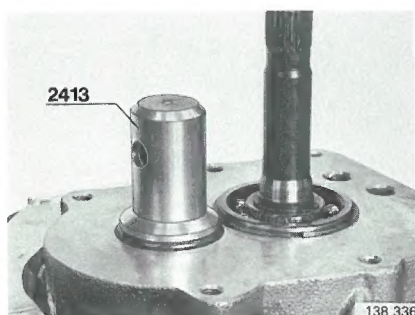
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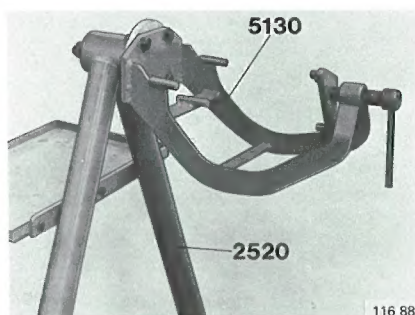
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134 325



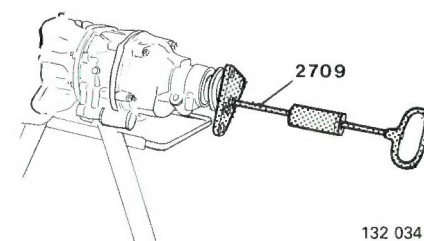
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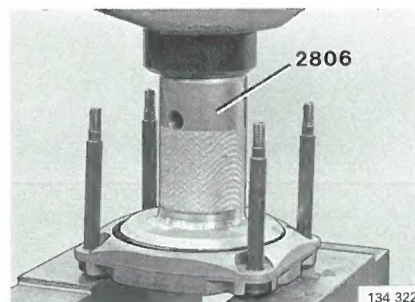
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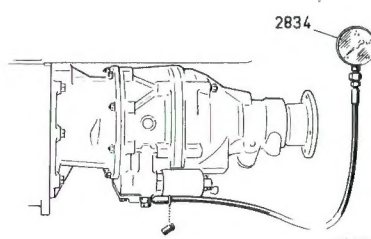
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132 034



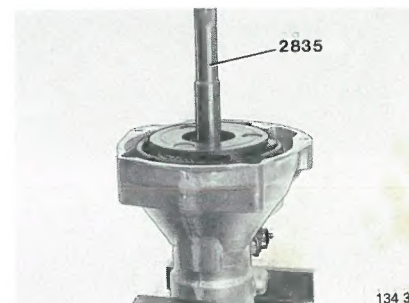
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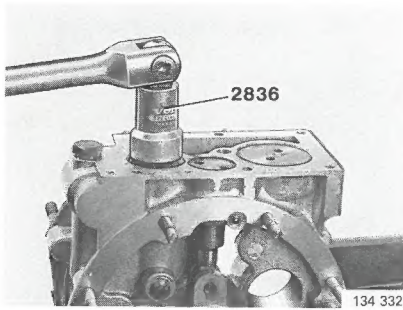
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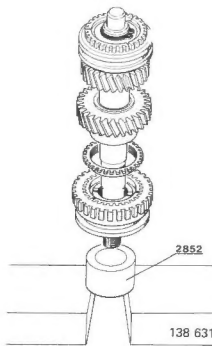
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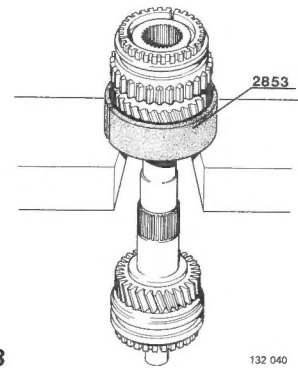
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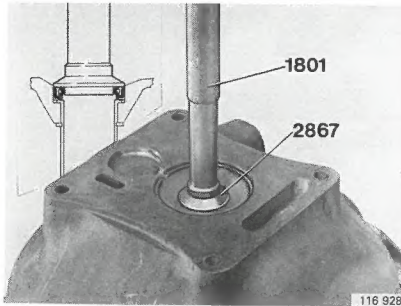
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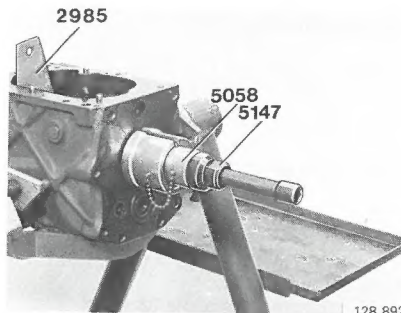
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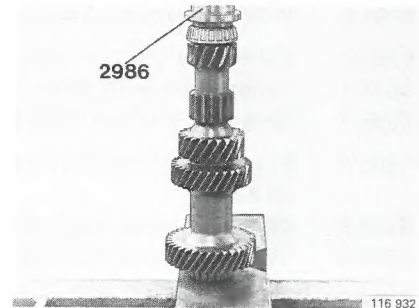
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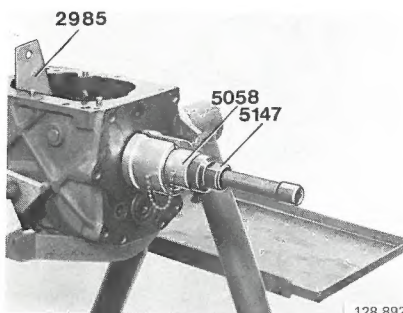
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128 892



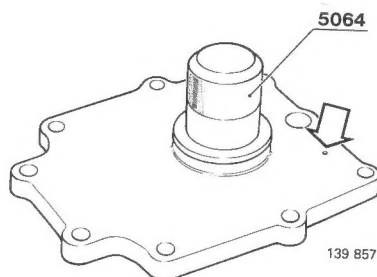
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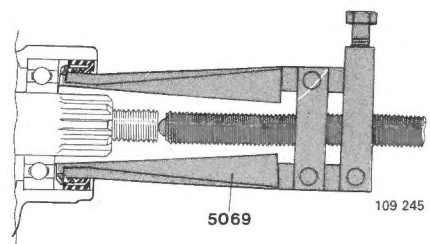
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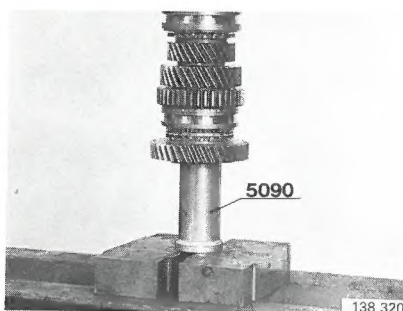
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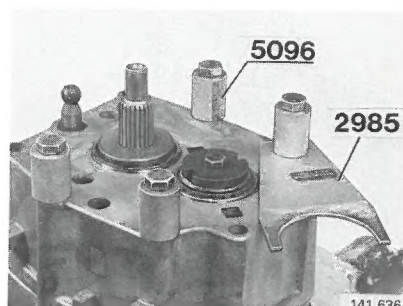
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109 245



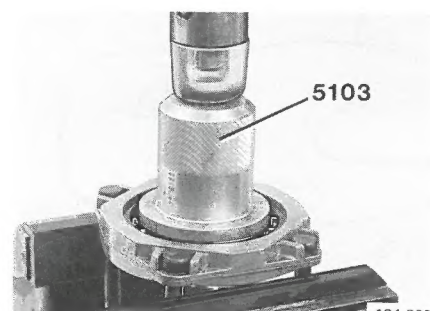
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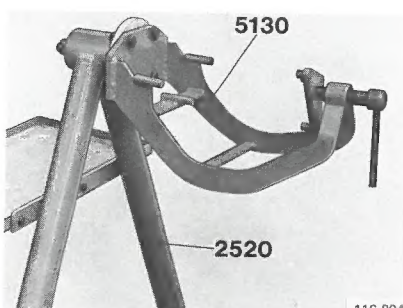
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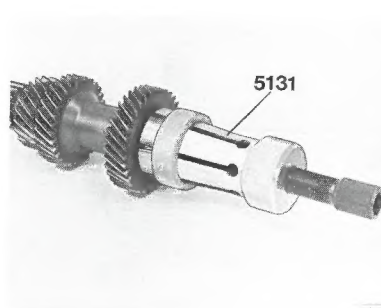
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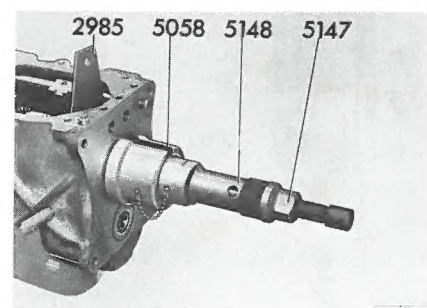
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5131

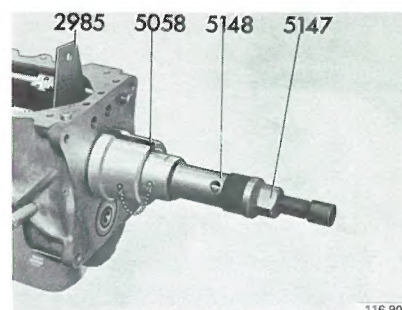
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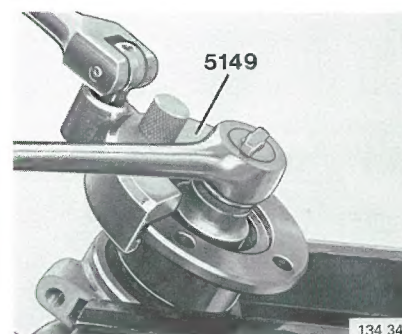
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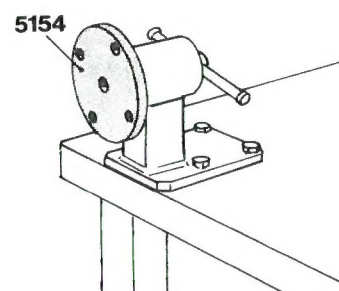
999	Description — use
5148-4	<b>Extension for 5058 (2 pcs)</b>
5149-3	<b>Wrench:</b> for round drive flange
5154-3	<b>Bench attachment:</b> for fixture 5130
5172-5	<b>Crow foot wrench:</b> for solenoid valve
5177-4	<b>Puller:</b> front bearing on countershaft, aluminium housing
5180-8	<b>Drift:</b> installing bearing on countershaft, aluminium housing
5183-2	<b>Puller:</b> for relief valve
5210-3	<b>Ring:</b> installing rollers in one-way clutch
5261-6	<b>Puller:</b> removing front bearing on countershaft
5262-4	<b>Puller:</b> 5th gear synchronizer hub
5304-4	<b>Puller:</b> removing drive flange
5305-1	<b>Ring:</b> for 5262 on M 47 II
5306-9	<b>Press tool:</b> installing bearing on main shaft and 5th gear M 47/ M 47 II
5308-5	<b>Drift:</b> installing rear housing seal, overdrive
5973-6	<b>Washer:</b> support for 998 7693 synchronizer/gear M 47 II
5986-0	<b>Shaft:</b> disassembling 5th gear synchronizer/gear M 47 II
998	
7693-0	<b>Puller:</b> removing 5th gear housing M 47/M 47 II
9177-0	<b>Torque gauge:</b> measuring damper torque



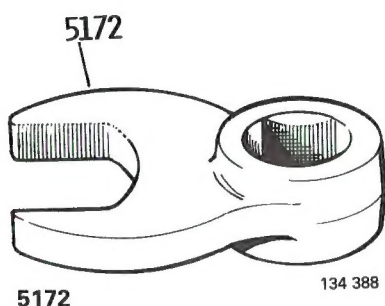
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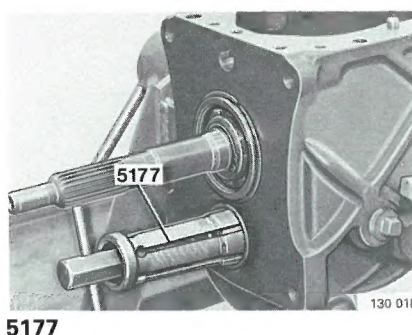
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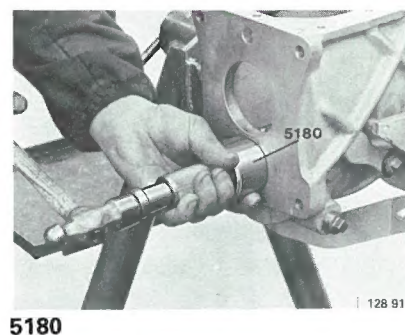
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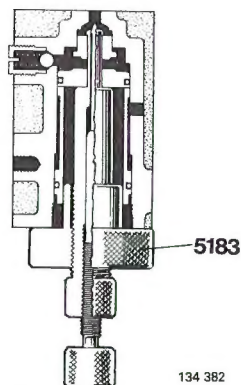
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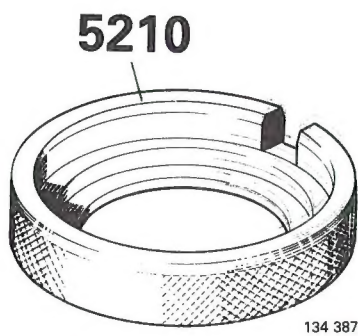
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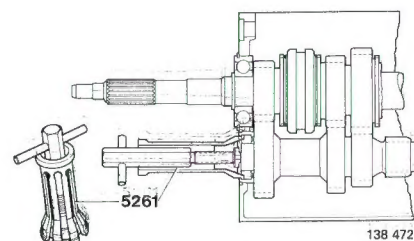
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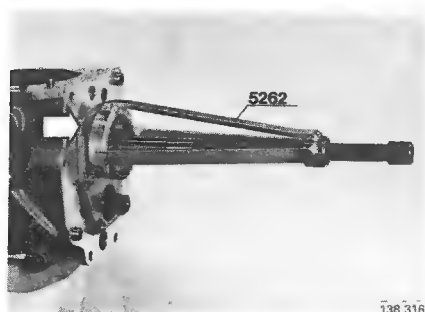


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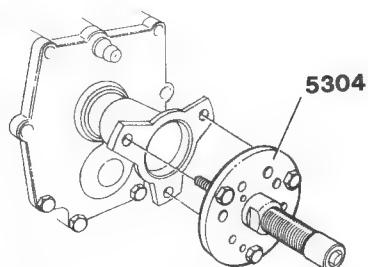
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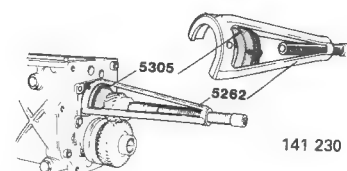
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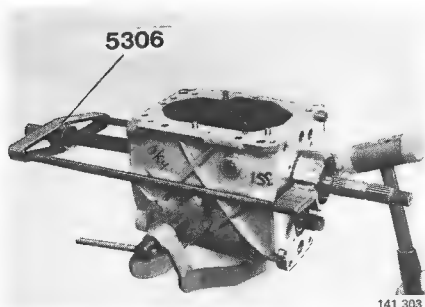
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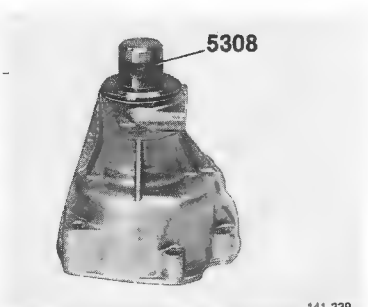
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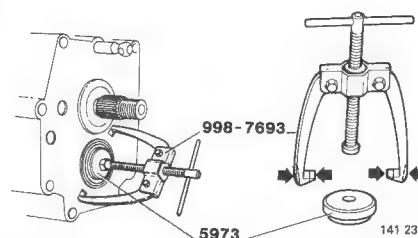
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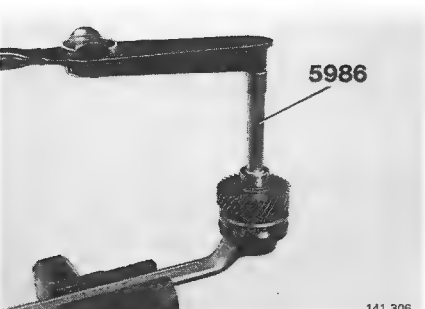


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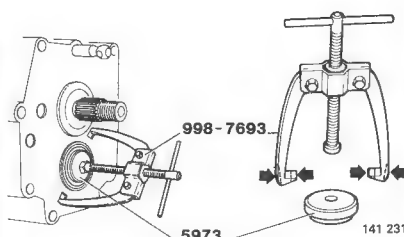


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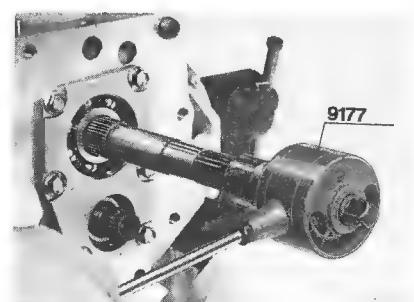


5986

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998 7693



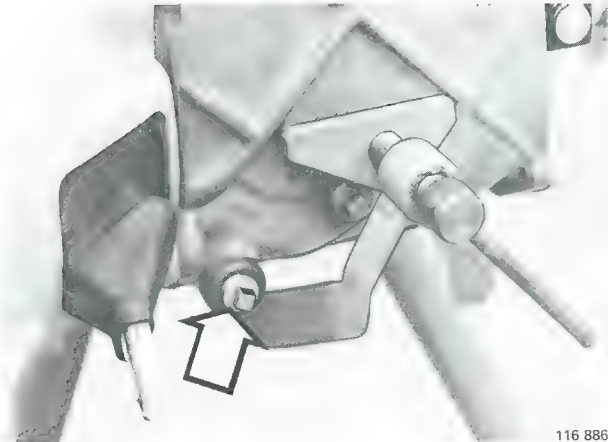
9177

138 330



## A. Disassembling M 46

*Special tools: 5130+2520 or 5154, 2709, 2853, 2985,  
5058, 5131, 5147, 5148 (2 pcs), 5177*

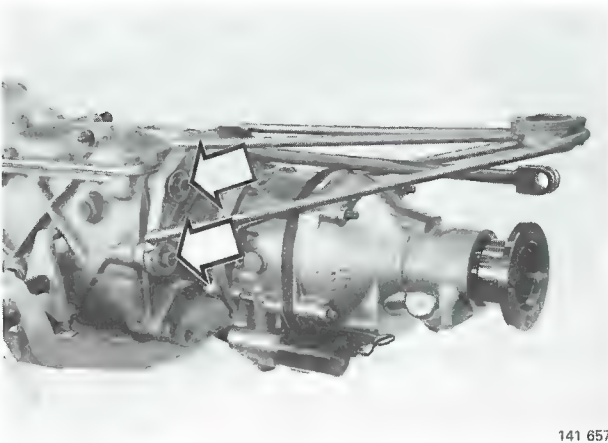


A1

**Mount transmission on fixture 5130 on floor stand 2520 or bench support 5154**

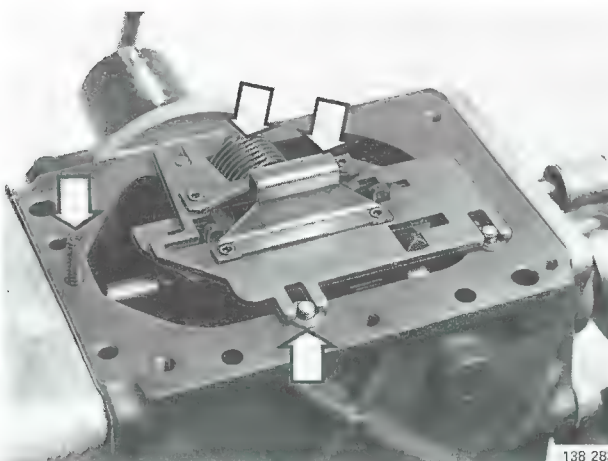
A2

**Drain oil**



A3

**Remove gear shift assembly**



A4

**Remove transmission cover and gasket**

A5

**Remove selector plate and return spring**  
Lift off washers, spring and ball.

A6

### Disconnect overdrive from intermediate housing

If required: use puller 2709

A7

### Remove gear selector rod

Tap out both lock pins.

A8

### Remove intermediate housing

Remove gasket.

Collect adjusting shims.

A9

### Remove clutch fork and clutch release bearing

Save spacer washer.

A10

### Remove clutch housing and gasket

Save adjusting shims.

Tap pipe rearwards to loosen seal. Some pipes have a lock ring, remove it first.

A11

### Tap out lock pin (1)

A12

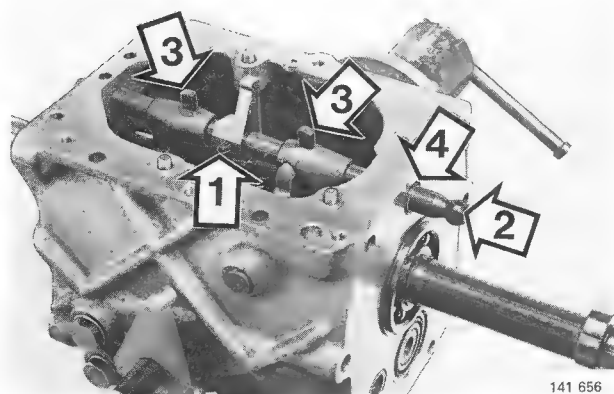
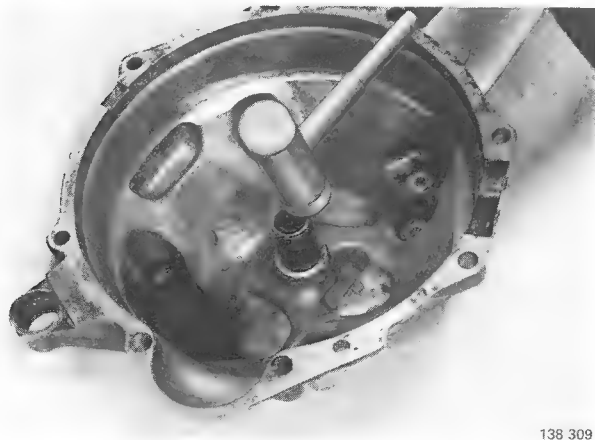
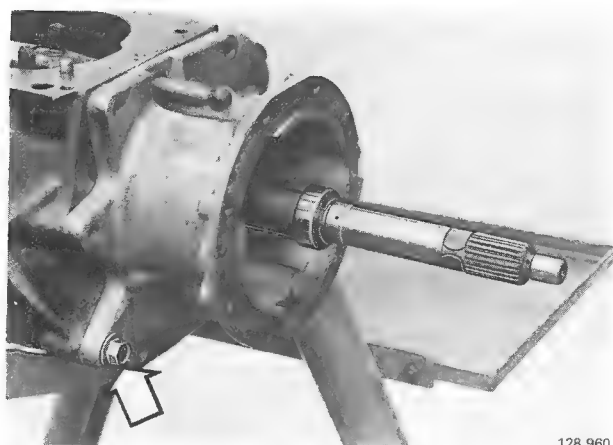
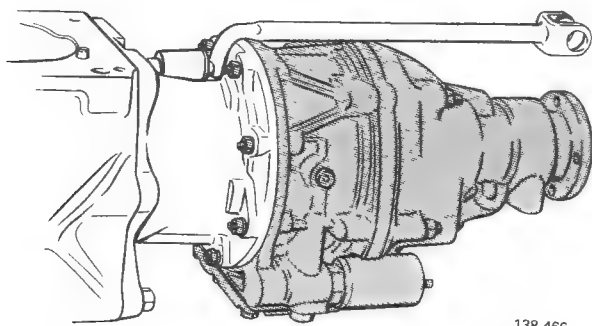
### Remove selector shaft (2)

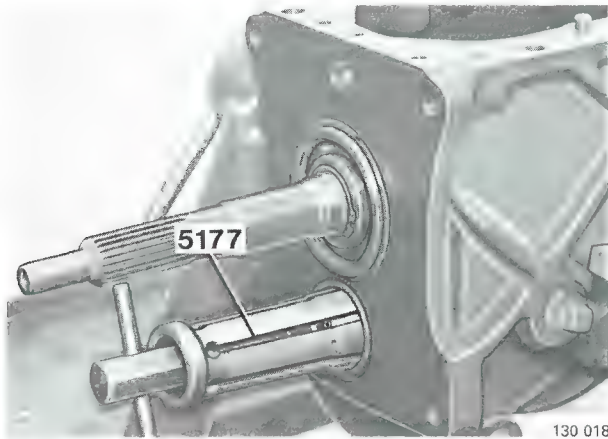
A13

### Remove shift forks (3)

A14

### Remove selector shaft seal (4)



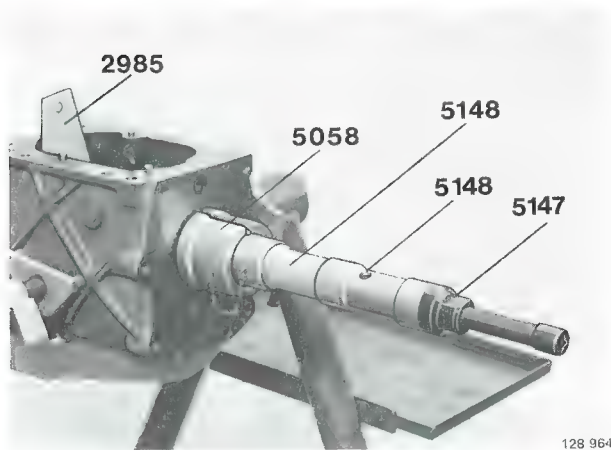


A15

#### Remove outer races for countershaft bearings

*Transmission with aluminum housing:*

Carefully tap shaft in both directions to enable puller 5177 to grip races.



A16

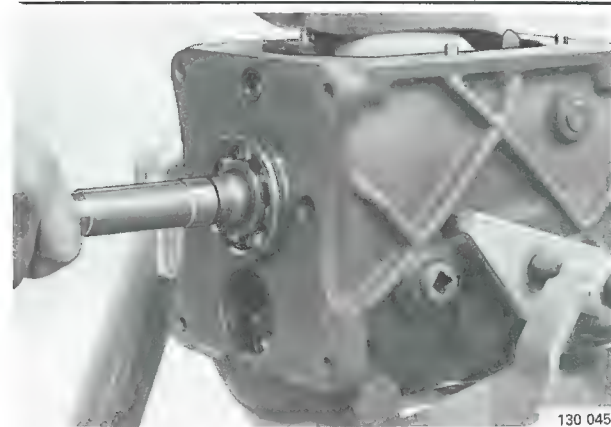
#### Remove main shaft bearings

Remove oil pump eccentric.

Remove lock ring and ring for main shaft bearing. Place tool 2985 between input shaft and front synchronizer.

Use puller 5058, two extensions 5148 and puller bolt 5147 to pull off bearing.

Remove bearing thrust washer but leave tool 2985 in position.



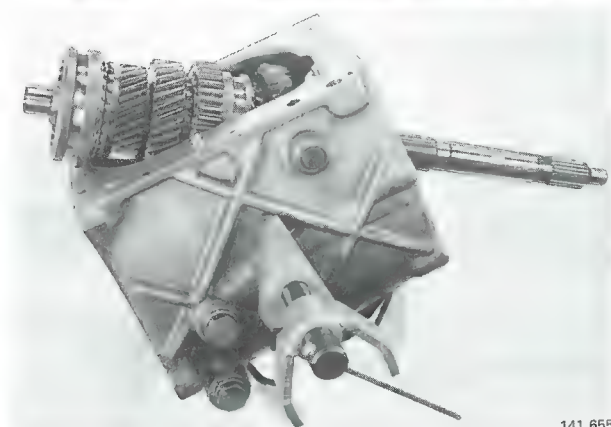
#### Removing all shafts

A17

#### Remove input shaft and synchronizer ring

Pull out shaft. If bearing sits tight in housing, leave tool 2985 in place and tap main shaft with a mallet.

**Note!** Make sure that front part of countershaft contacts bottom of housing.



A18

#### Lift out main shaft

First turn transmission.

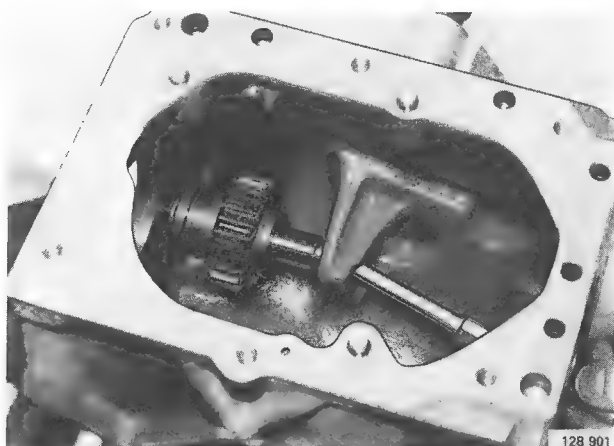
A19

#### Lift out countershaft

Turn transmission back.

Use a plastic mallet to tap out rear bearing race. Remove shaft.





A20

**Remove reverse gear wheel and shaft**

Use a drift to push shaft rearwards.

A21

**Remove selector for reverse gear**

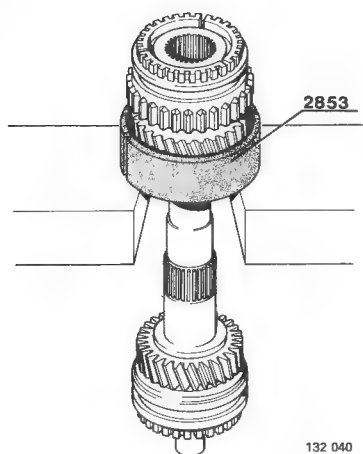
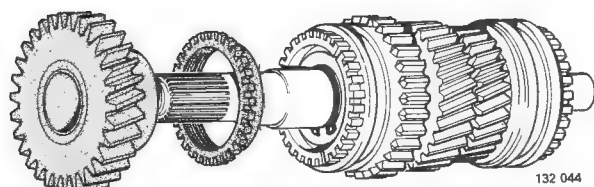
**Disassembling main shaft**

*Transmission equipped with damper:*

A22

**Press off washer, remove springs and brake ring.  
Remove 1st gear with synchronizer ring.**

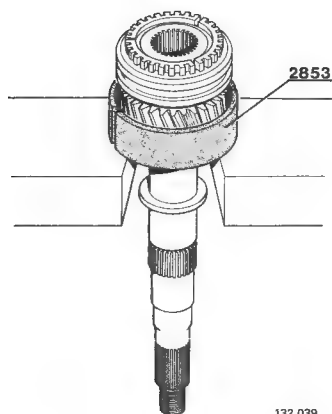
Remove lock ring for synchronizer hubs.



A23

**Press off 1st—2nd synchronizer hub and 2nd gear  
wheel with synchronizer ring**

Use support 2853.



A24

**Press off 3rd—4th synchronizer hub and 3rd gear  
wheel**

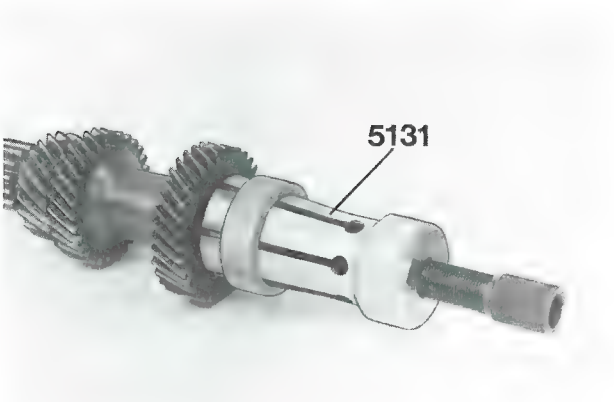
Use suport 2853.



116 925

**Disassemble synchronizers**

A25

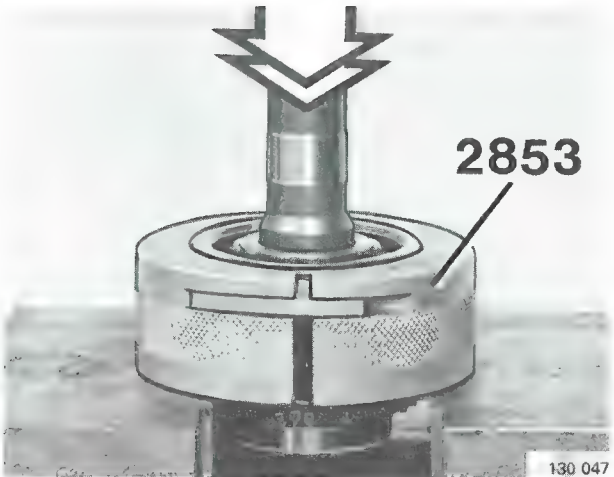


116 913

**Remove countershaft bearing**

Use puller 5131.

A26



130 047

**Remove input shaft bearing**

Use support 2853.

A27

**Clean and examine all parts**

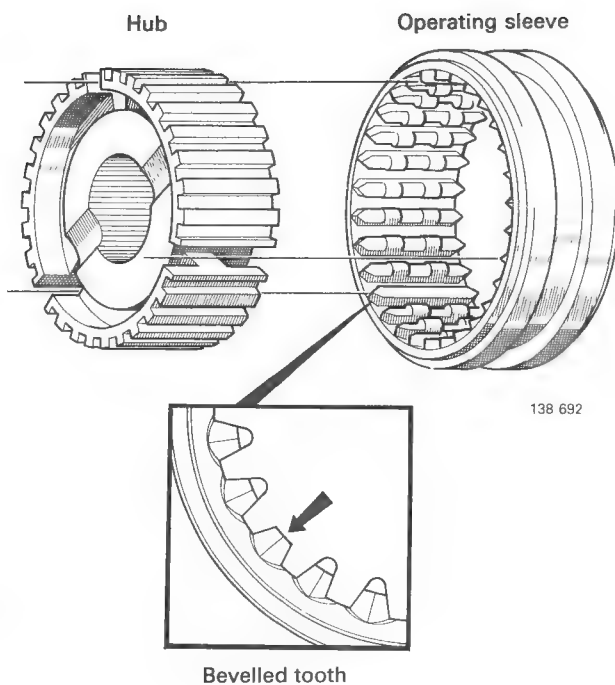
Wash all parts with solvent. Dry with compressed air.

Examine all parts. Replace worn or damaged parts and all seals and gaskets.

A28

## B. Assembling M 46

Special tools: 1801, 2852, 2853, 2867, 2986, 5090, 5180, 5306



### Assembling main shaft

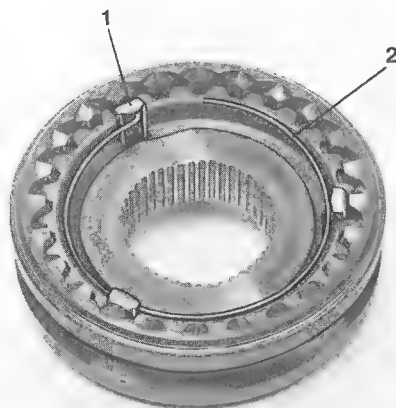
B1

#### Assemble both synchronizers

Place hub in operating sleeve.

3rd-4th gear synchronizer:

Three recesses in hub should align with the three bevelled teeth in operating sleeve.



B2

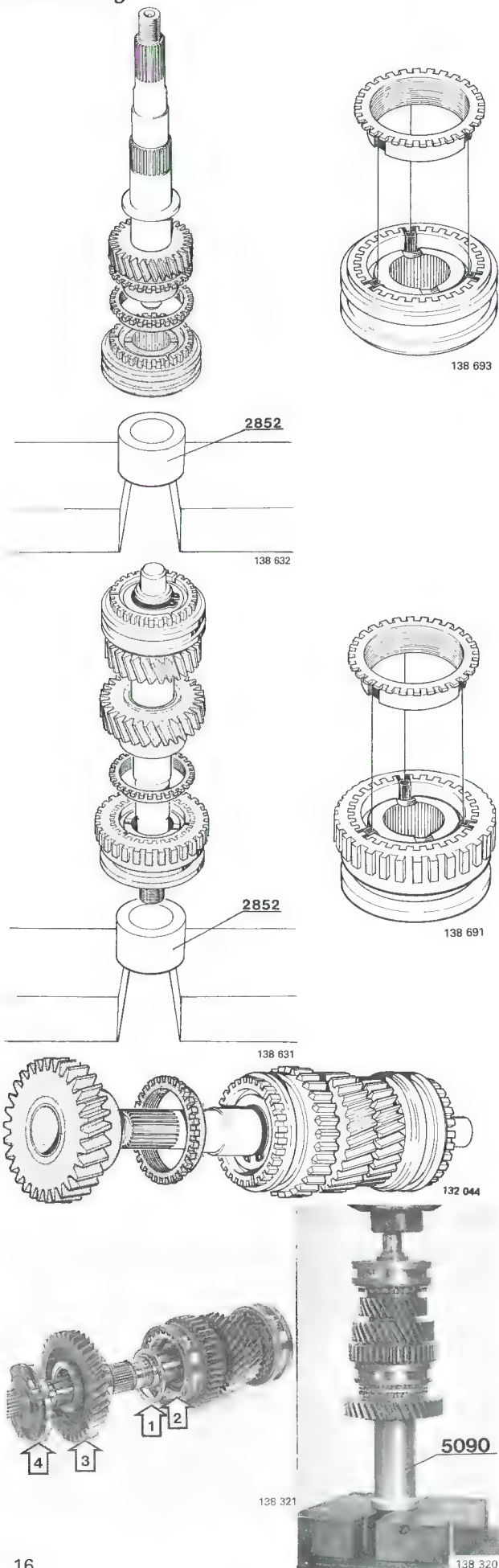
#### Install sliding keys (1) and springs (2)

Lock sliding keys ("dogs") with springs. Hook both springs to the same sliding key.

Install one spring counter-clockwise. Turn synchronizer over and install second spring, also counter-clockwise.

If spring is bent, free end must point away from hub.





B3

**Oil main shaft. Install 3rd gear wheel and synchronizer.**

**Press on 3 rd–4th gear synchronizer hub.**

**Note!** On some transmissions, the gear wheel has a needle bearing. Make sure that it is fitted.

Make sure synchronizer ring is facing correct way. Turn wear surface on synchronizer hub UP.

Use support **2852**.

**Invert shaft**

B4

**Oil shaft. Install 2nd gear wheel and synchronizer. Press on 1st–2nd gear synchronizer hub.**

Make sure synchronizer ring is fitted correctly.

Use support **2852**.

B5

**Install lock rings for both synchronizers**

*Transmission without damper:*

B6

**Install synchronizer ring and gear wheel for 1st gear**

*Transmission with damper:*

B7

**Install thrust washer (1), if applicable, synchronizer ring (2) and gear wheel (3) for 1st gear**

B8

**Assemble damper**

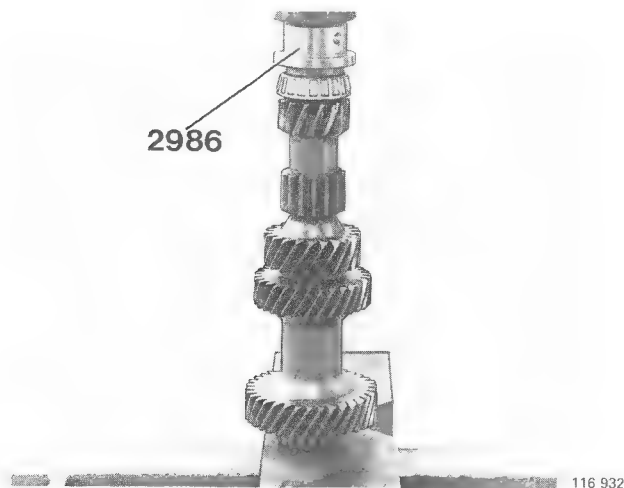
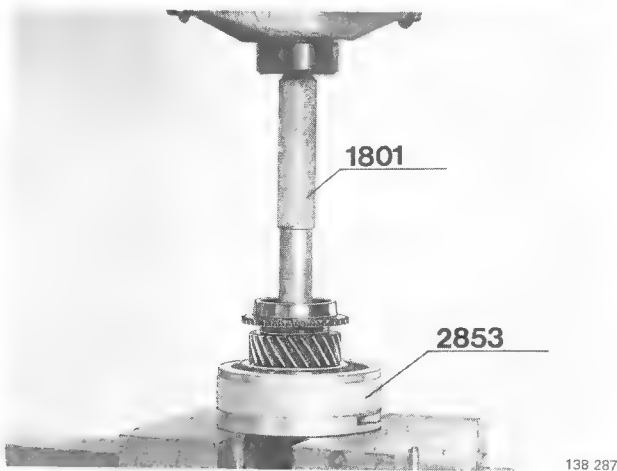
Oil parts. Position springs in brake ring and twist washer into brake ring.

B9

**Press damper (4) on main shaft**

Use a file to remove sharp edges. Use tube **5090** when pressing on damper.

B10

**Press both bearings on main shaft**Use drift **2986**.**Note!** Two types of rear bearings. Check transmission serial number to see that correct bearing is used.

B11

**Press bearing on input shaft**Use standard handle **1801** and support **2853**.

B12

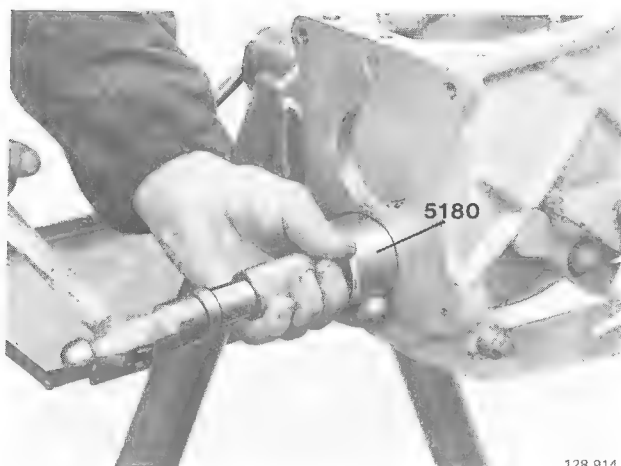
**Install lock ring on input shaft**

*For transmissions with cast iron housing: proceed to operation B22.*

*Operations B13–B21 only apply to transmissions with aluminium housing.*

**Determining thickness of countershaft shims**

*The countershaft should have a preload of 0.03–0.05 mm (0.0012–0.0020 in). If countershaft, countershaft bearing or rear end bearing was replaced, shim thickness must be determined.*

**Note!** Apply assembly paste to aluminium surfaces prior to installing bearings and shafts.

Part Number 1 161 006-0 Aerosol  
1 161 078-9 Can

B13

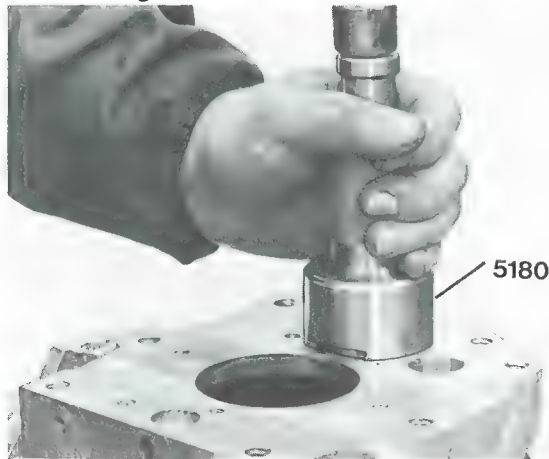
**Install countershaft in housing**

B14

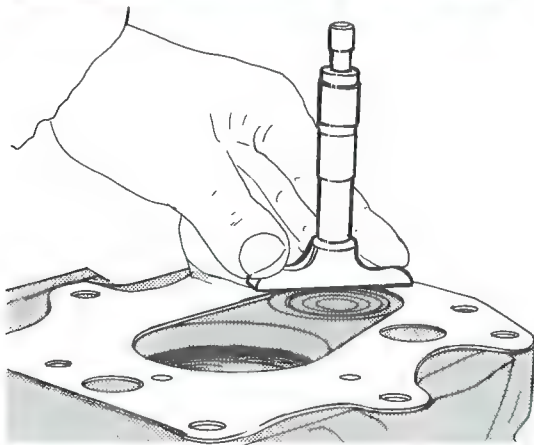
**Install front bearing race for countershaft**

Use drift **5180** large end facing race. Let race protrude approx. 1 mm (0.04 in). It will take up correct position when installing clutch cover.

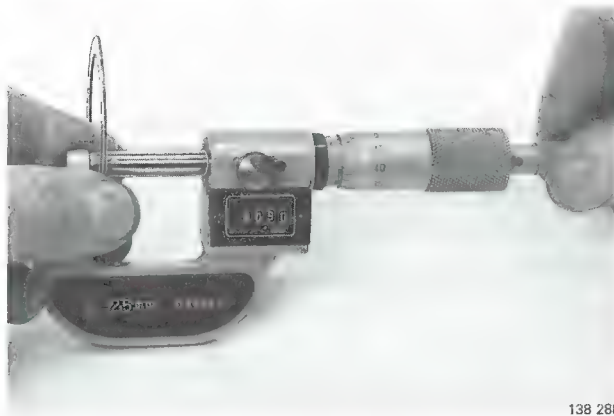
## Assembling



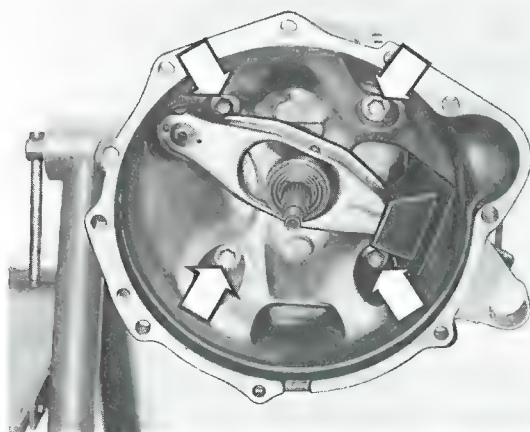
128 916



138 620



138 288



128 893

B15

**Install clutch housing and gasket**

Torque to 35–50 Nm (25–35 ft lb).

B16

**Turn transmission so that rear end faces UP**

B17

**Install rear bearing race for countershaft**

Use drift **5180** small diameter facing rear bearing race. Make sure bearing has no play. Rotate shaft and tap until there is no play (shaft has light resistance).

B18

**Measure distance between outer bearing race for countershaft and housing end face including gasket**

Position gasket on end face.  
Use depth micrometer and note distance.

B19

**Calculate thickness of shim for countershaft**

Preload should be +0.03 to –0.05 mm. (+0.0012 to –0.0020 in)

**Example:**

	mm	in	mm	in
Distance bearing race to gasket face	1.79	0.0705	1.79	0.0705
Clearance/preload	–0.03	–0.0012	+0.05	+0.0020
	1.76	0.0693	1.84	0.0725

Choose shim 1.80 mm (0.0709 in). If possible, choose shim of thickness to obtain countershaft preload. Following shims are available:

P/N	mm	in
949048–3	0.05 mm	0.002 in
948298–5	0.10 mm	0.004 in
948299–3	0.15 mm	0.006 in
948300–9	0.35 mm	0.014 in
948301–7	0.50 mm	0.020 in
948302–5	0.70 mm	0.028 in
948303–3	1.00 mm	0.040 in

B20

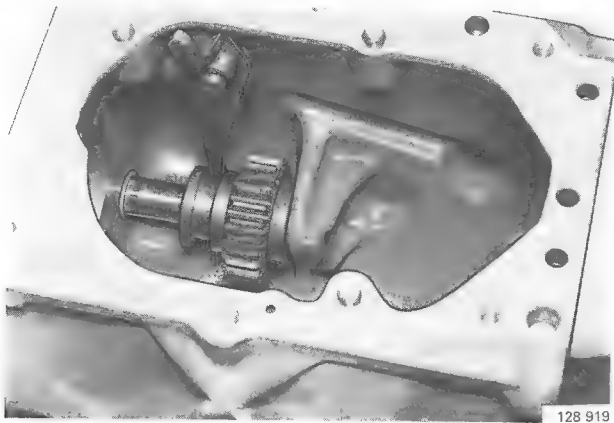
**Remove clutch cover and gasket**

B21

**Remove countershaft**

Continue assembling transmission as described for transmission with cast iron housing. The only difference is installing countershaft and determining shim thickness, as described above.





128 919

## Installing shafts in transmission housing

B22

### Install gear selector for reverse gear

Install lock ring for shift fork.

B23

### Install reverse gear wheel and shaft

B24

### Check/adjust position of reverse gear shaft

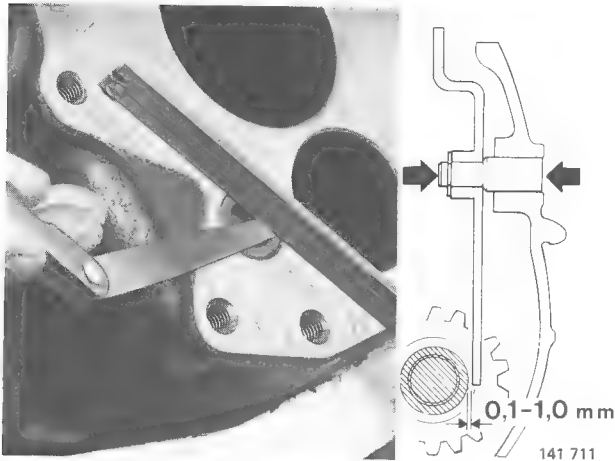
Shaft end should be flush with housing or max. 0.05 mm (0.002 in) inside housing face. See left.

B25

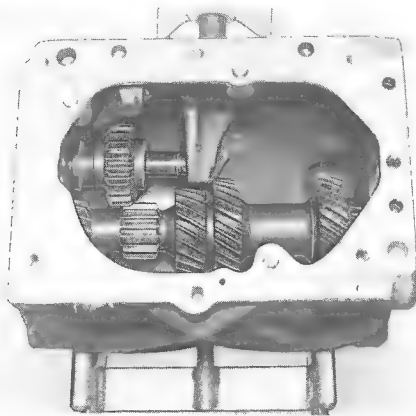
### Check/adjust clearance between reverse gear wheel and shift fork

Adjust by tapping shift fork bearing stud, using a drift. See right illustration.

Correct clearance: 0.1–1.0 mm (0.004–0.040 in).



141 711



128 922

B26

### Place countershaft in bottom of housing

B27

### Place main shaft in housing

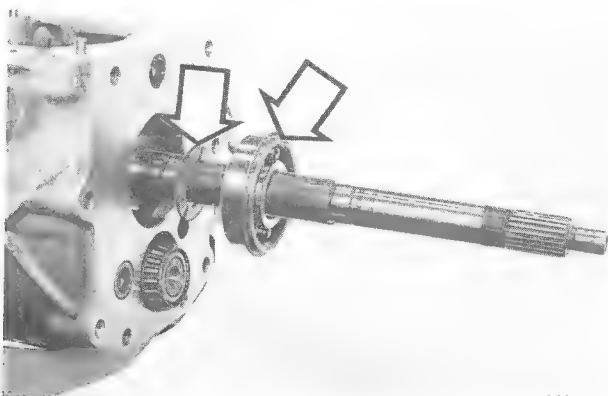
First turn housing

## Installing main shaft rear bearing

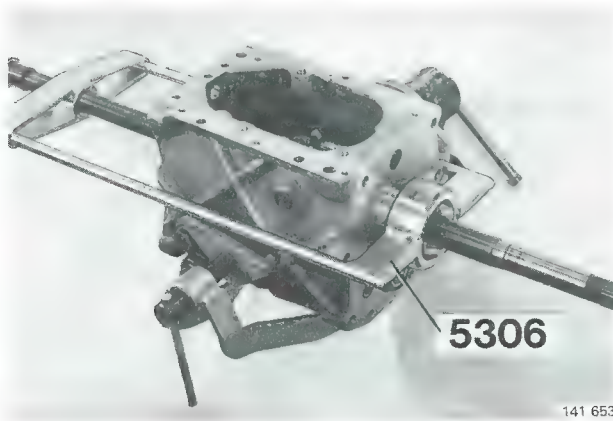
B28

### Install thrust washer (only transmissions without damper) and bearing with lock ring on main shaft

Countershaft should be positioned in bearings.



141 654



B29

**Press main shaft bearing into position**

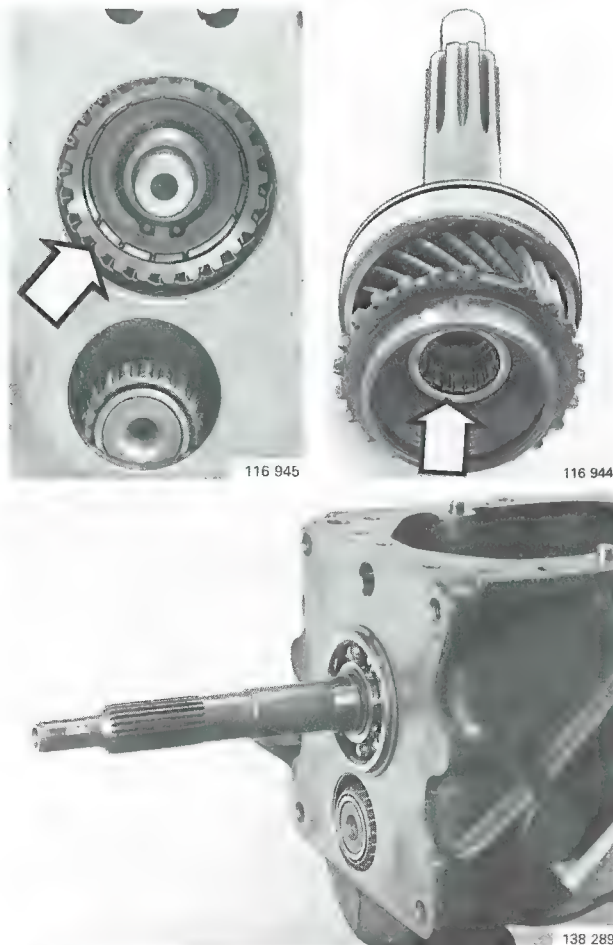
Use press tool 5306.

Make sure gear teeth do not clash and become damaged when pressing on bearing.

B30

**Make sure lock ring on bearing contacts housing**

If required, tap press tool with a mallet until bearing positions correctly.



**Installing input shaft**

B31

**Position 4th gear synchronizer ring in synchronizer hub**

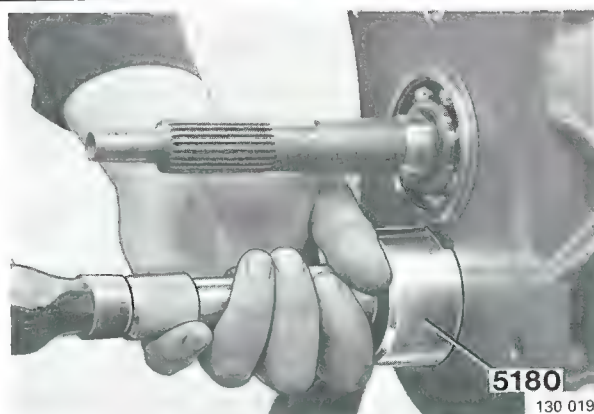
B32

**Grease and install roller bearing in input shaft**

B33

**Install input shaft, lift countershaft**

Tap bearing outer race with a mallet if bearing is stiff. Place countershaft bearings in position before input shaft.



B34

**Install outer races for countershaft**

Transmission with aluminium housing:

Use drift 5180.

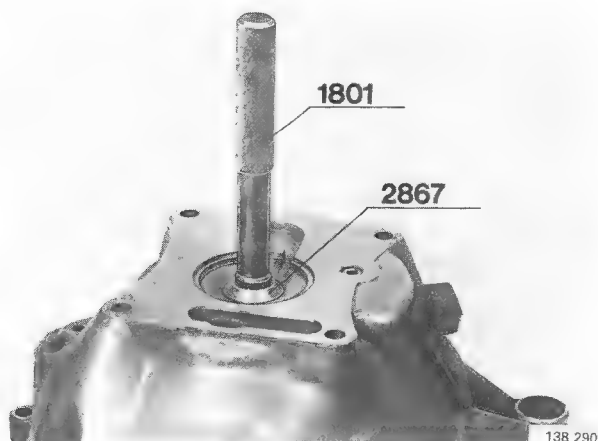
Front bearing: large end of drift.

Rear bearing: small end of drift.

B35

**Grease and install seal in bell housing**

First check that tube bottoms.

Use drift **2687** and standard handle **1801**.**Determining thickness for shim on input shaft**

Input shaft should have an end clearance of 0.01–0.20 mm (0.0004–0.0080 in). If bearing on input shaft or bell housing was replaced, shim thickness must be determined.

B36

**Measure distance between outer face of input shaft bearing and front face of transmission**

Make sure lock ring on bearing abuts housing.

Use depth micrometer and note reading.



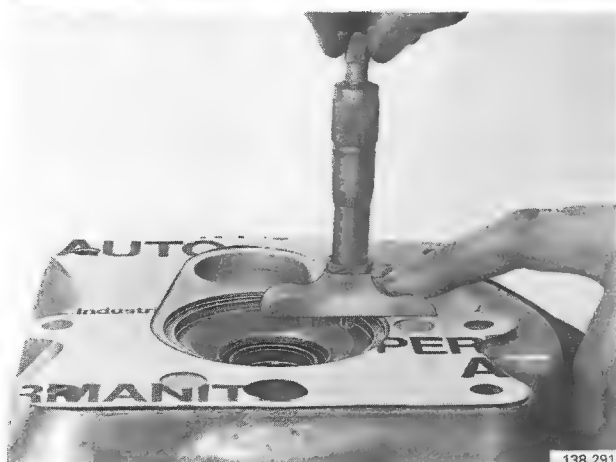
B37

**Position gasket on clutch housing**

B38

**Measure distance between outside of gasket and bottom of bearing seat**

Note reading.





B39

**Calculate shim thickness for input shaft**

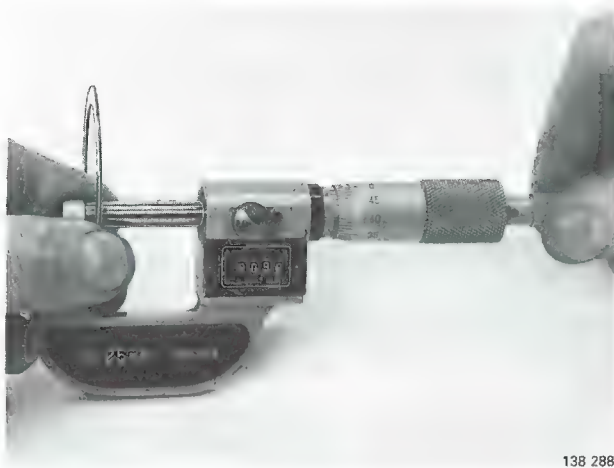
Permissible end play. 0.01–0.20 mm (0.0004–0.0080 in).

Example:

Distance:	mm	in
– Gasket face to bearing recess	5.80	0.2283
– Bearing to transm. housing	<u>–4.85</u>	<u>–0.1909</u>
	<u>=0.95</u>	<u>=0.0374</u>
Deduct end play	–0.01	–0.0004
	<u>to 0.20</u>	<u>to 0.0080</u>
Determined shim thickness:	<u>=0.75</u>	<u>=0.0294</u>
	<u>to 0.94</u>	<u>to 0.0370</u>
Select shim thickness	<u>0.90 mm</u>	<u>0.035 in</u>

Following shim thicknesses are available:

P/N	mm	in
3292838–4	0.25	0.010
948008–X	0.60	0.024
948009–6	0.75	0.030
948010–4	0.90	0.036
948011–2	1.00	0.040



138 288

**Installing clutch housing ("bell housing")**

B40

**Grease transmission gasket face and install gasket**

B41

**Position shim in clutch housing**

Apply grease to hold shim in position.

B42

**Install clutch housing**

Torque to 35–50 Nm (25–35 ft lb)

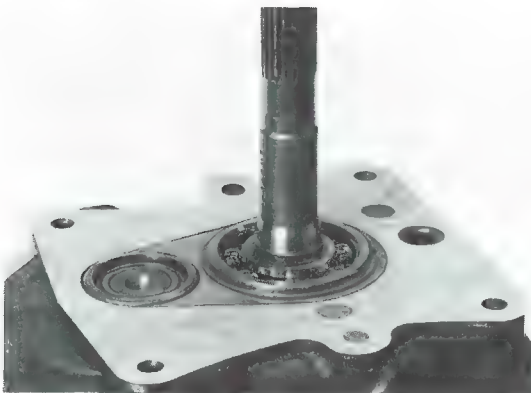
B43

**Install clutch fork, spacer washer and clutch release bearing**

Prior to installing, grease bearing sliding surface and ball joint.

Sparingly apply grease to splines. (Do not forget washer under ball joint.)

*Transmissions with aluminium housing: proceed to operation B46.*



138 292

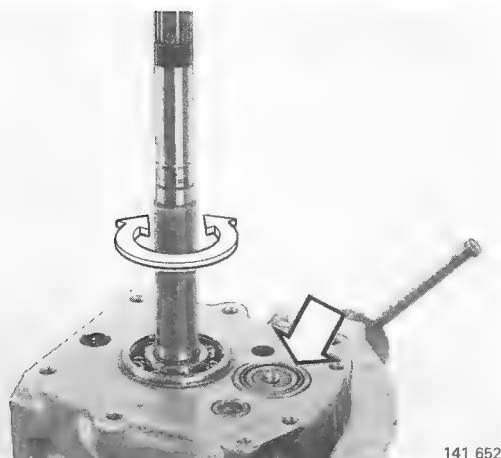


128 915

*Operation B44–B45 only apply to transmissions with cast iron housings.*

### Determining thickness for shim on countershaft

End float should be 0.025–0.10 mm (0.001–0.004 in). If the countershaft, any of its bearings, or the rear case/intermediate housing have been replaced the shim thickness should be determined.

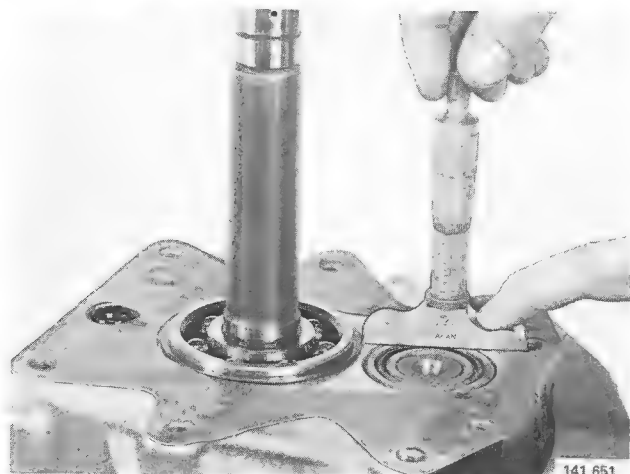


141 652

#### B44

#### Make sure bearing races are correctly positioned

Depress races while turning main shaft a couple of turns until bearing rollers have centered.



141 651

#### B45

#### Position gasket. Measure distance between countershaft outer bearing race and gasket face.

Use depth micrometer and note reading.

Example:	mm	in
Distance race to gasket face	1.68	0.0661
permitted end float	–0.025	–0.0001
	<u>to 0.10</u>	<u>to 0.0040</u>
	= 1.58	= 0.0660
	<u>to 1.655</u>	<u>to 0.0621</u>

Select shim thickness **1.65 mm**. (0.066 in)

Following shim thicknesses are available:

P/N	mm	in
949048–3	0.05	0.002
948298–5	0.10	0.004
948299–3	0.15	0.006
948300–9	0.35	0.014
948301–7	0.50	0.020
948302–5	0.70	0.028
948303–3	1.00	0.040

## Determining thickness for shim on main shaft

Main shaft end float should be 0.01–0.20 mm (0.0004–0.0080 in). If a main shft bearing or the intermediate section has been replaced or the shim thickness should be determined.

**B46**

**Position gasket. Measure distance between outer face of main shaft bearing and rear face of transmission housing**

Make sure bearing spacer ring abuts housing.

Use depth micrometer and note reading.



141 650

**B47**

**Measure distance between intermediate section contact face and bottom of bearing seat**

Note reading.



141 649

**B48**

### Calculate shim thickness

Permitted end float: 0.01–0.20 mm (0.0004–0.0080 in).

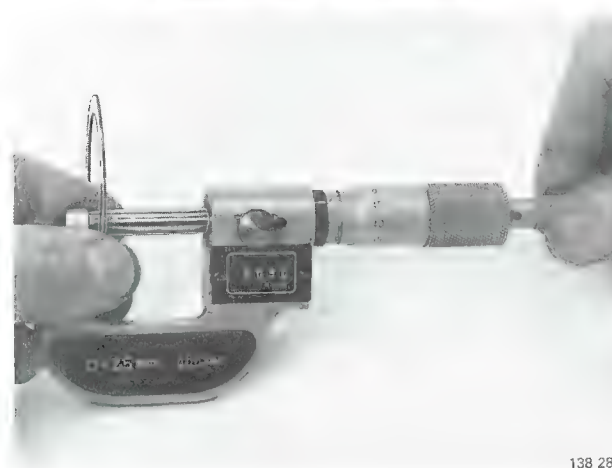
Example:

Distance:	mm	in
– Face to seat	5.50	0.2165
– Bearing to gasket face	–4.46	–0.1756
	<u>=1.04</u>	<u>=0.0409</u>
Deduct end float	–0.01	–0.0004
	<u>to 0.20</u>	<u>to 0.0329</u>
	to 0.84	to 0.0405

Select shim thickness **1,00 mm** (0.040 in).

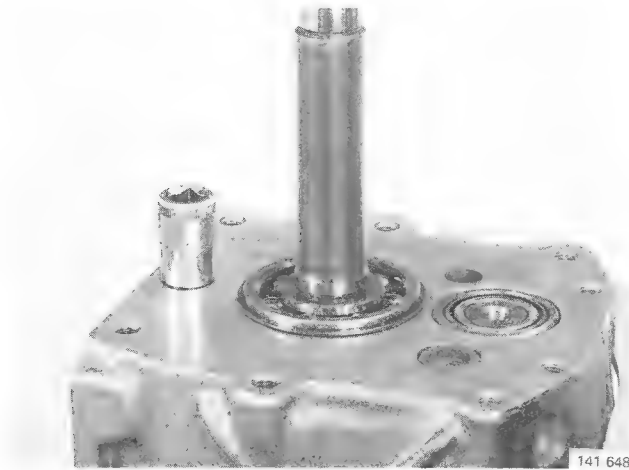
Following shim thicknesses are available:

	mm	in
948008-4	0.60	0.024
948009-6	0.75	0.030
948010-4	0.90	0.036
948011-2	1.00	0.040



138 298





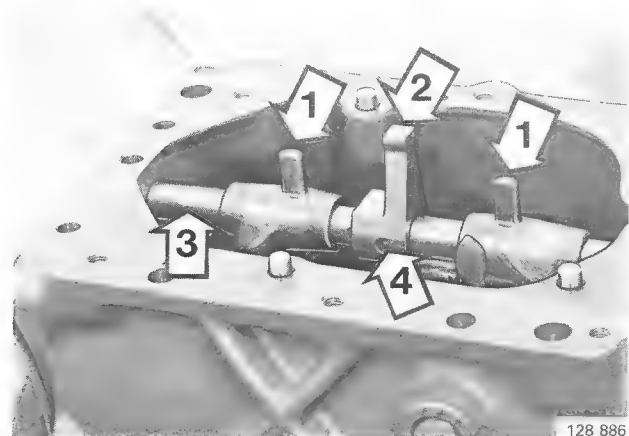
141 648

## Installing intermediate section

B49

### Install selector shaft seal in housing

Use a socket to depress seal.



128 886

### Install shift forks (1)

Make sure lugs face correctly.

B50

### Install gear selector (2) and selector shaft (3)

Gear selector collar forwards, grooves in selector shaft facing UP.

B51

### Install lock pin (4) in gear selector

B52

B53

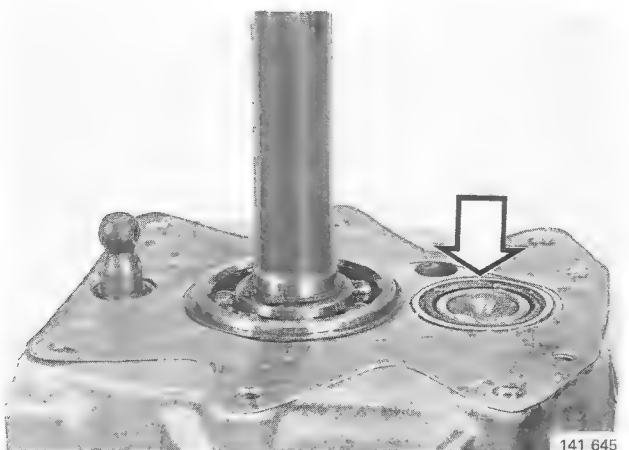
### Install lock ring for bearing and oil pump cam with lock ring

Install key for cam in main shaft.

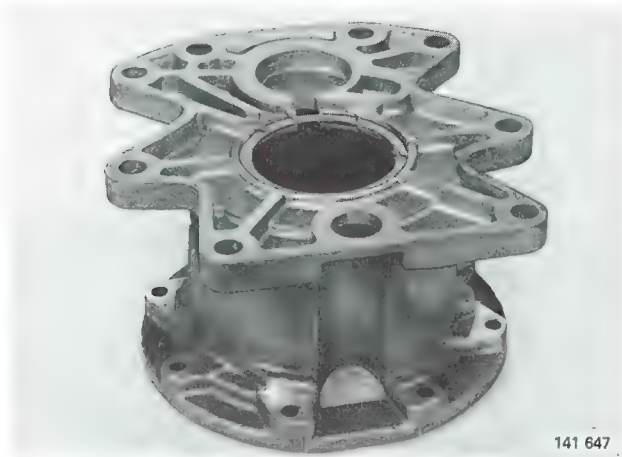
B54

### Grease transmission rear face. Position gasket and shims for countershaft

Grease shims to hold them in position.



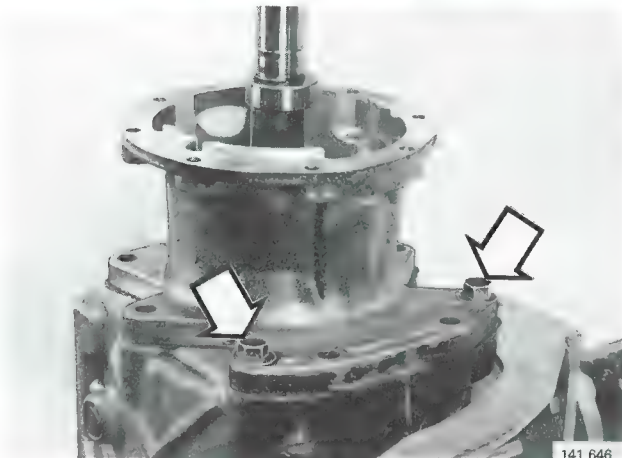
141 645



B55

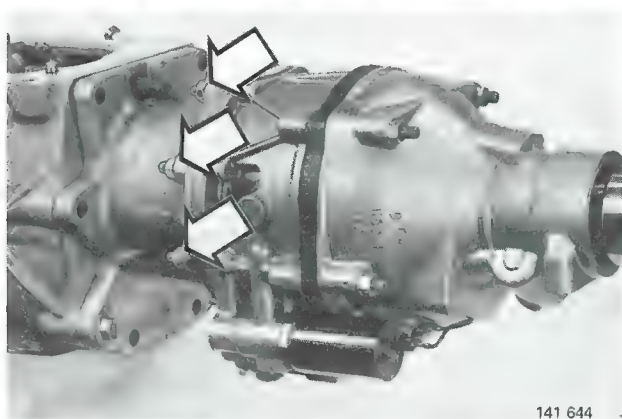
**Position main shaft shims in intermediate section**

Use grease to hold shims in position.



B56

**Install intermediate section**



B57

**Install overdrive**

Torque bolts to 12 Nm (9 ft lb).



B58

**Install selector rod**

Grease and install rubber ring in joint. Use sleeve to lock pins.

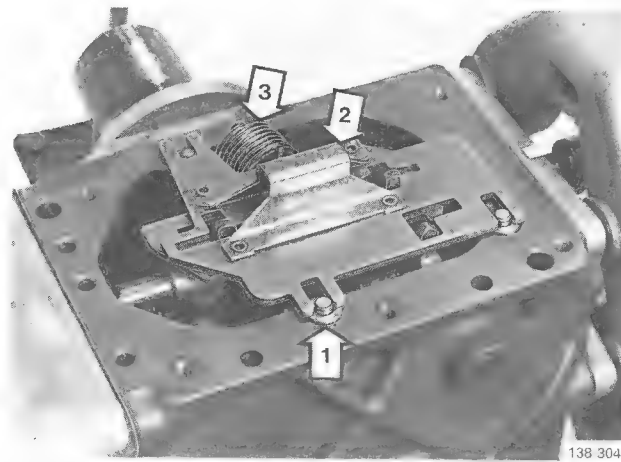
B59

**Install selector bracket**

**Note:** Bolt-washer-spacer tube-washer.

Torque bolts for rear end.

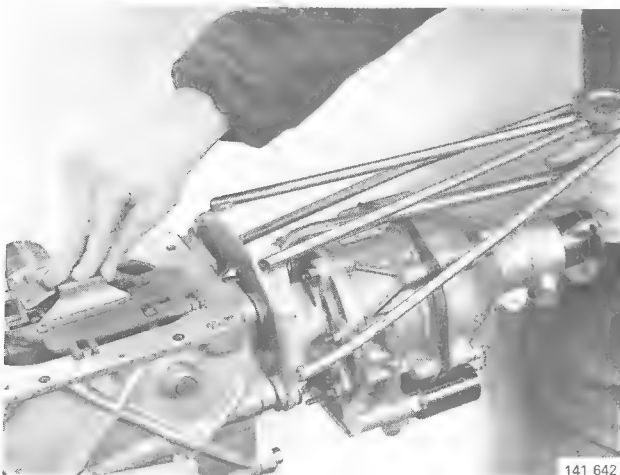
Torque: 35–50 Nm (25–35 ft lb).



138 304

B60

**Install washers (1), selector plate (2) and return spring (3)**

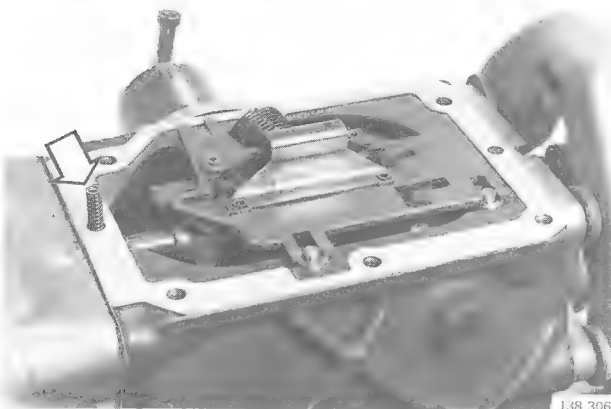


141 642

B61

**Check function**

Move selector plate by hand to check that all gears can be engaged and disengaged.



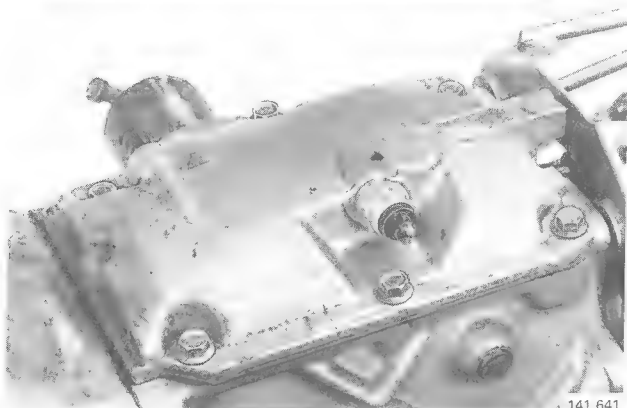
138 306

B62

**Grease contact face and position gasket**

B63

**Install interlock ball and spring**



141 641

B64

**Install transmission cover**

Torque bolts to 15–25 Nm (11–20 ft lb).

B65

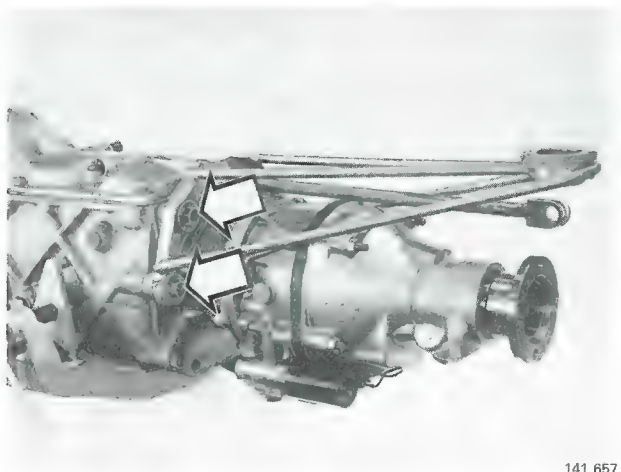
**Install reversing light (back-up light) switch**

Also install overdrive switch and attach wire from solenoid.



B66

**Check that all overdrive bolts are tight and that there are no leaks**

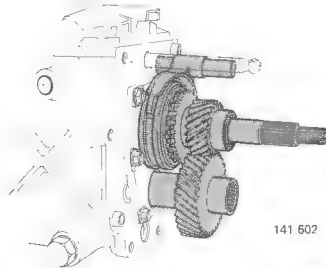


141 657

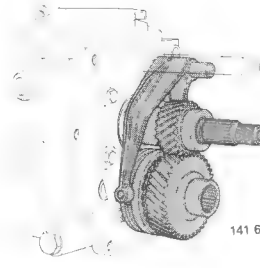
## C. Disassembling M 47, M 47 II

*Special tools: 5130+2520 or 5154, 2853, 2985, 5058, 5131, 5147, 5148, 5261, 5262, 5304, 5305, 5973, 5986*

On M 47 II the 5th gear synchroizer is on the counter shaft. On the early version (M 47–1985) it is on the main shaft.

**M 47**

141 602



141 603

**M 47 II**

C1

**Mount transmission on fixture 5130 on floor stand 2520 or bench support 5154**

C2

**Drain oil**

C3

**Remove transmission cover and gasket**

Remove selector plate.

C4

**Remove selector plate**

Lift off washers, spring and interlocking ball.

C5

**Remove clutch fork**

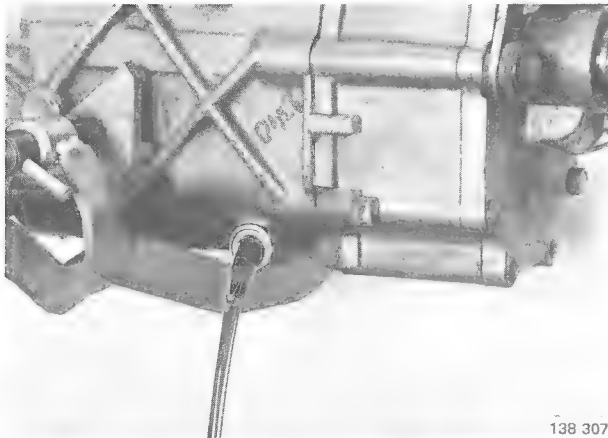
Save spacer washer. Remove release bearing.

C6

**Remove clutch housing ("bell housing") and gasket**

Save adjusting shims.

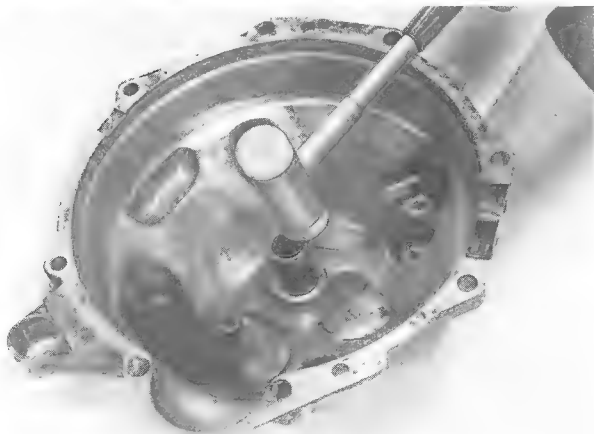
Tap pipe rearwards to loosen seal. Some pipes have a lock ring, remove it first.



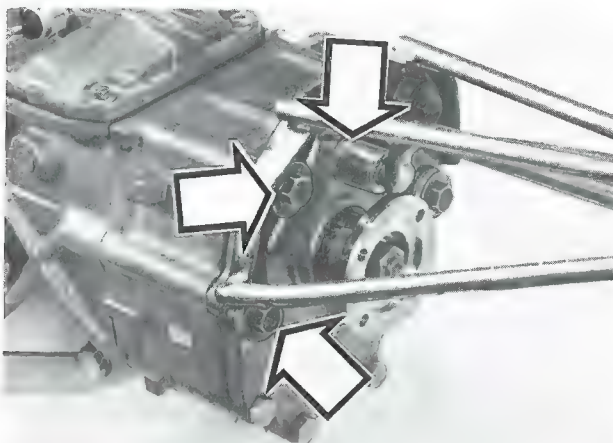
138 307



138 308



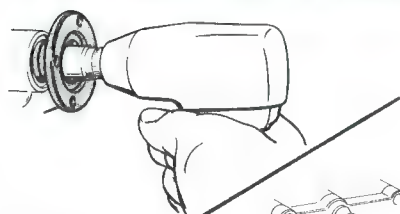
138 309



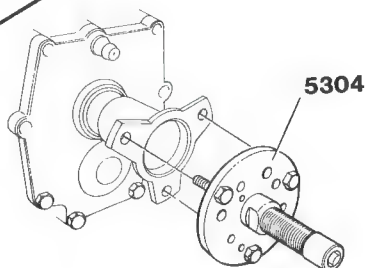
141 640

C7

**Remove gear selector bracket and selector rod**



138 457



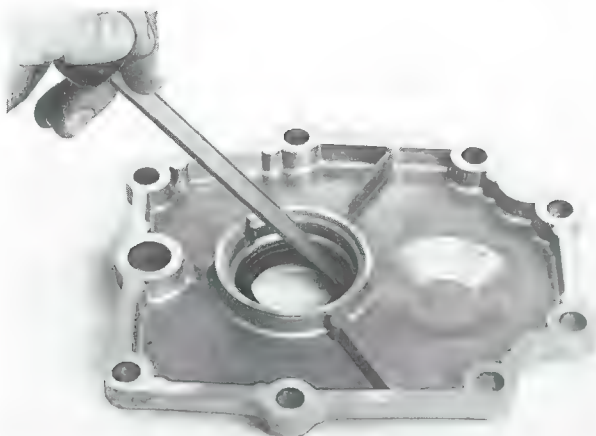
141 227

C8

**Remove drive flange**

Engage two gears to lock transmission, prior to loosening nut.

If drive flange is difficult to remove, use puller **5304**. It fits both the round and three-armed drive flanges.



141 310

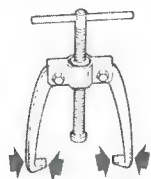
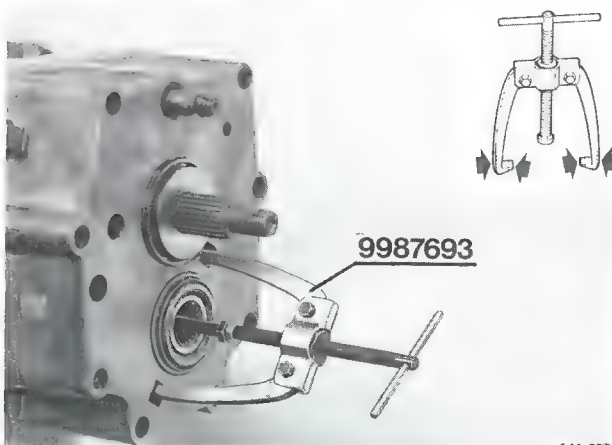
C9

**Remove rear end cover and gasket**

C10

**Remove rear end cover seal**

*M 47 II: proceed to operation C22.*



9987693

141 639

*Operations C 11 to C 21 only refer to M 47.*

**Removing 5th gear, M 47**

C11

**Remove bolt, washer and shims for countershaft**

Reinstall bolt, 5–6 turns, no washer.

**Pull off 5th gear housing**

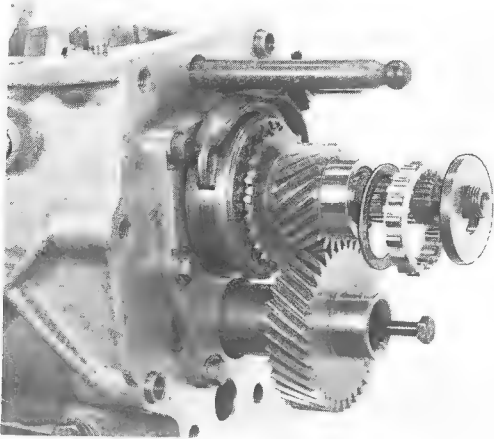
C12

Use puller **998 7693-0**

**Note:** Puller claws should be ground as shown. Remove gasket.

Remove selector shaft seal.

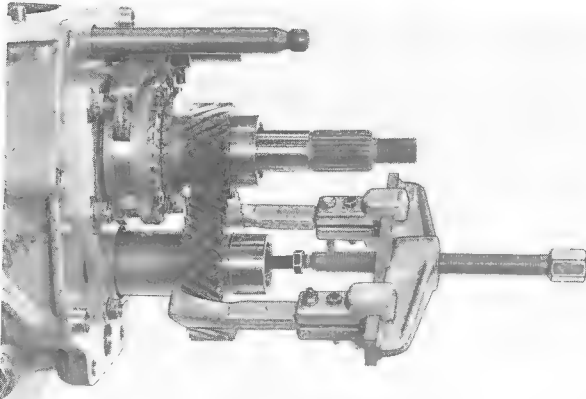




141 638

C13

**Remove thrust washer and roller bearing with washer**



138 313

C14

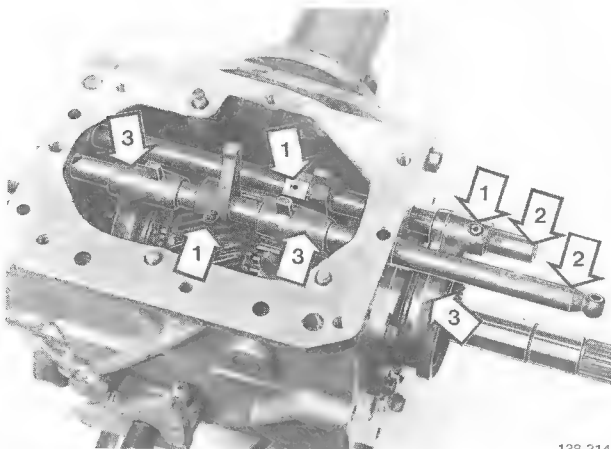
**Pull off gear wheel from countershaft**

Use universal puller.

C15

**Remove gear wheel with needle bearing, support ring and synchronizer ring from main shaft**

Remove long bolt from countershaft.



138 314

C16

**Tap out three pins (1)**

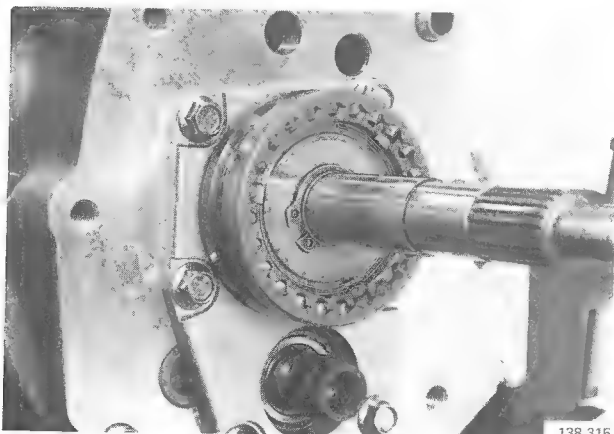
Support shafts to prevent them from bending when pins are removed.

C17

**Pull out selector shafts (2)**

C18

**Remove shift forks (3)**

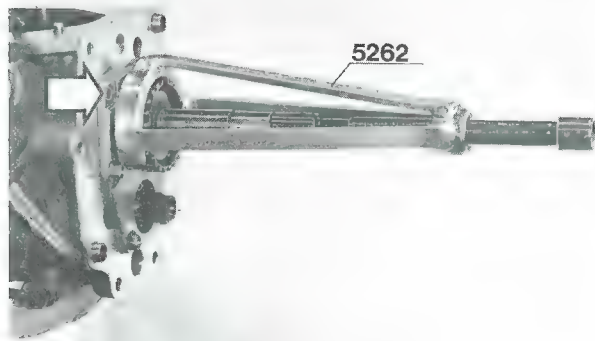


138 315

C19

**Remove spring. Disassemble 5th gear synchronizer.**

Remove lock ring for hub.



138 316

C20

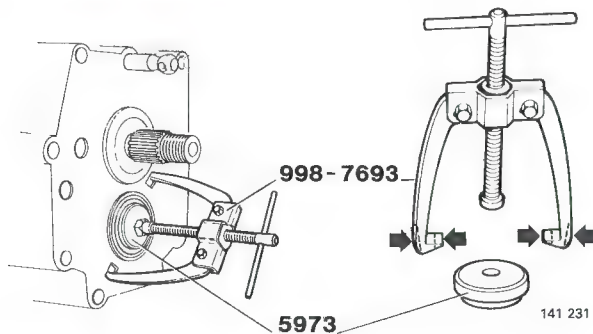
**Remove two upper screws retaining bearing holder**

C21

**Pull off hub**

Use puller 5262.  
Save adjusting shims.

*Proceed to operation C32.*



*Operations C22 to C31 only apply to M 47 II.*

**Removing 5th gear, M 47 II**

C22

**Remove bolt, washer and countershaft shims**

C23

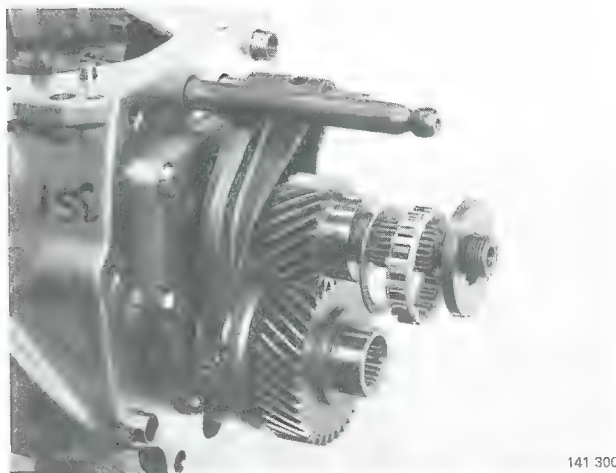
**Pull off 5th gear housing**

Refit bolt with washer 5973. Tighten bolt by hand until it bottoms.

Use puller 998 7693 to pull off 5th gear housing.

**Note:** grind puller claws as shown.

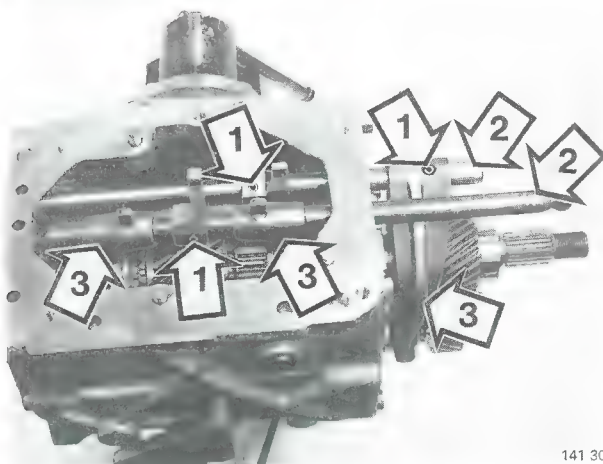
Remove gasket and selector shaft seal.



141 300

C24

**Remove thrust washer and roller bearing with washer**



141 309

C25

**Tap out three pins (1)**

Support shafts to prevent them from bending when pins are removed.

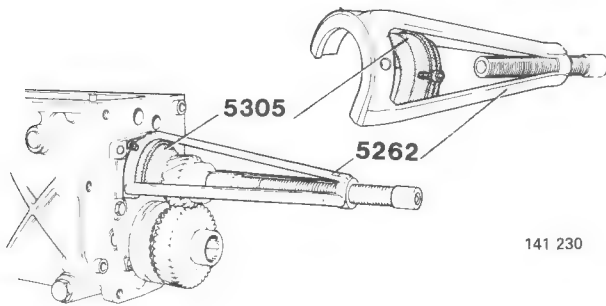
C26

**Pull out selector shafts (2)**

C27

**Remove shift forks (3)**

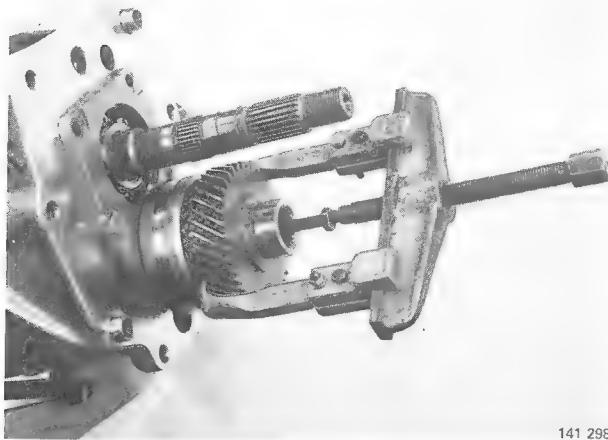
C28

**Pull off 5th gear wheel**

Remove two upper bearing holder screws.

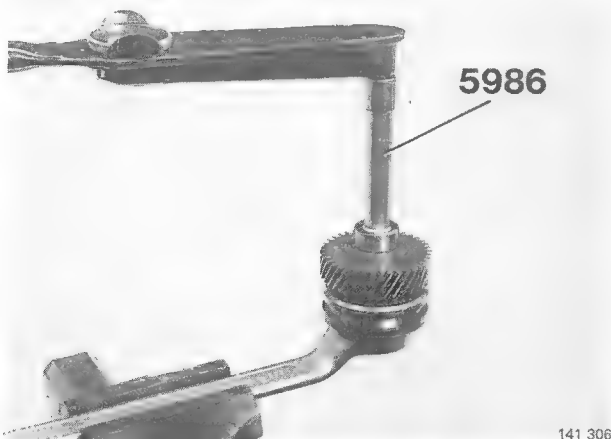
Use puller **5262** and ring **5305**.

C29

**Pull off 5th gear wheel and synchronizer**

Use universal puller, supported on bolt head.

C30

**Disassemble 5th gear wheel/synchronizer**

Clamp a box-end wrench in a vice. Place synchronizer nut in wrench.

Use shaft **5986** plus torque wrench to loosen nut.

**Note:** If nut comes loose at a lower torque than 30 Nm (22 ft lb), a **new nut** should be used when reassembling.

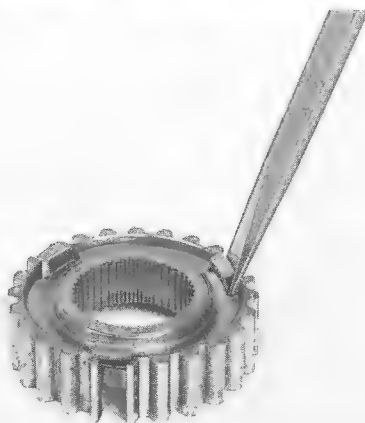
Dismantle parts.

C31

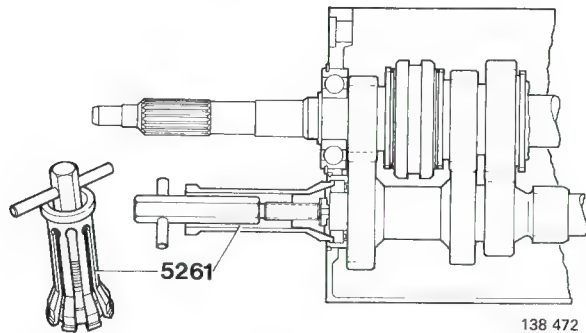
**Remove washer on 5th gear synchronizer hub**

This operation should only be performed if a part is to be replaced.

Use screwdriver to pry washer loose.





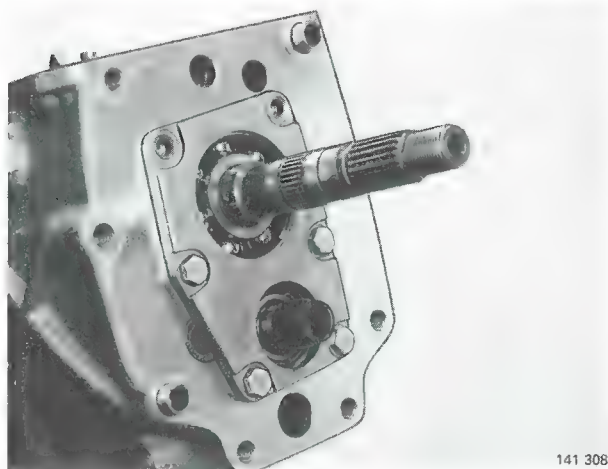


C32

### Pull out front countershaft bearing

Use puller 5261.

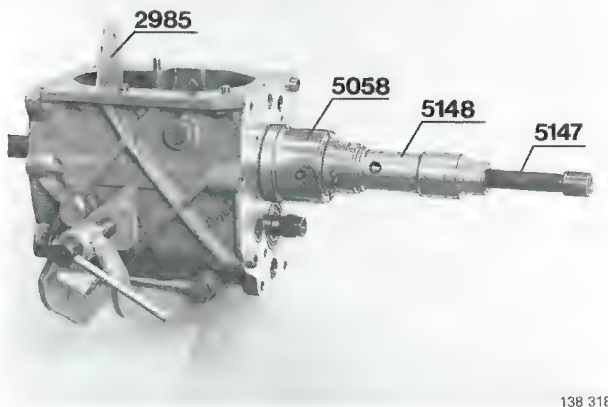
Insert puller claws between rollers, pull out spindle to expand puller and pull out bearing.



C33

### Remove bearing holder from rear face

Save adjusting shims.

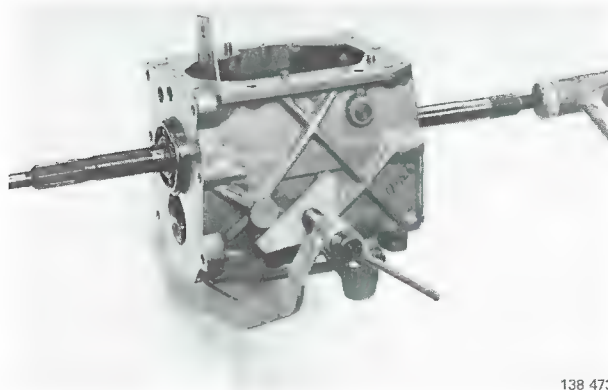


C34

### Remove rear main shaft bearing

Position support 2985 between input shaft and front synchronizer ring. Remove lock ring and bearing.

Use puller 5058 (without spindle), extension 5248 and puller bolt 5147.



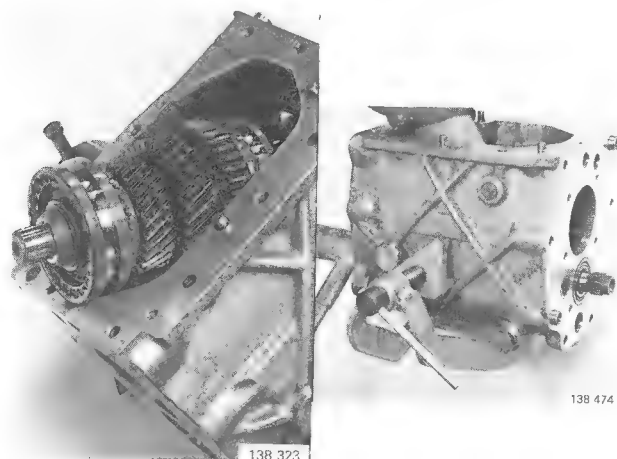
### Removing all shafts

C35

### Remove input shaft with synchronizer ring

Pull out shaft. If bearing is hard to remove leave support 2985 in position and tap main shaft with a mallet.

**Note:** Make sure that front part of countershaft abuts bottom of housing.



C36

### Remove main shaft

Turn transmission and remove main shaft.

C37

### Remove countershaft

Turn transmission back. Tap out rear bearing race with a plastic mallet. Remove countershaft.

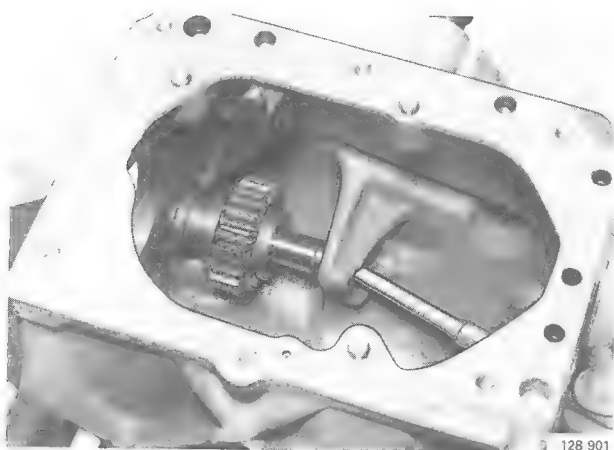
C38

### Remove reverse gear and shaft

Use a drift to force shaft rearwards.

C39

### Remove reverse gear shift fork

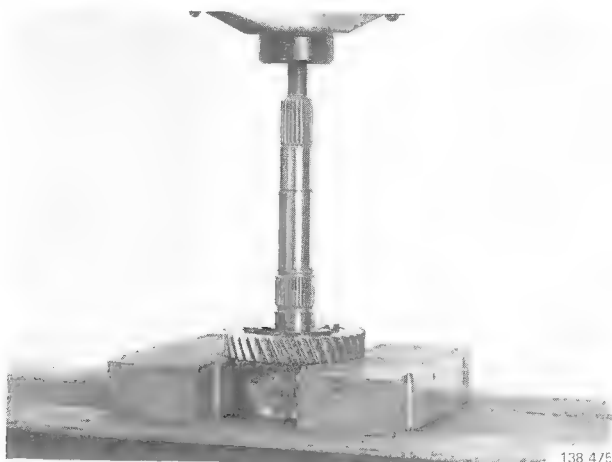


## Disassembling main shaft

*Transmission with damper:*

C40

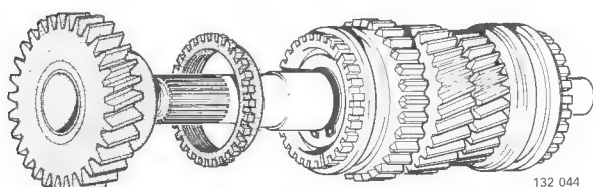
**Press off washer. Remove springs and brake ring**

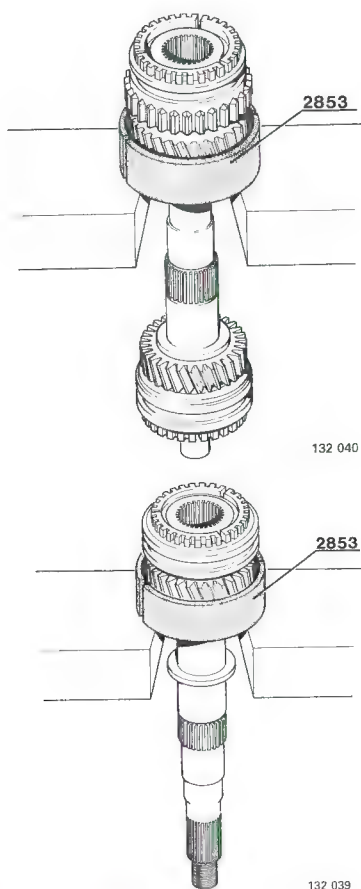


C41

### Remove thrust washer and 1st gear wheel with synchronizer ring

Remove lock rings for synchronizer hubs.





C42

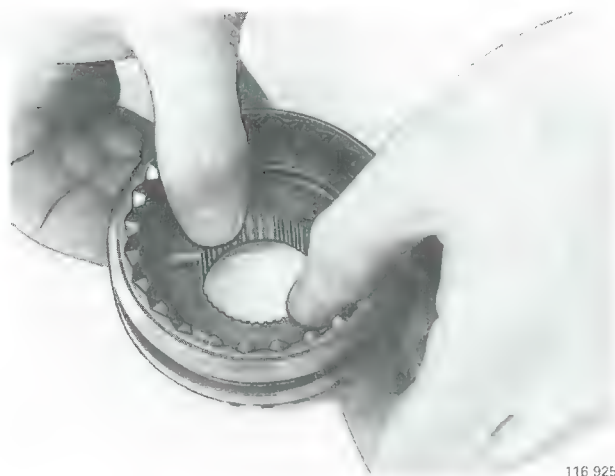
**Press off 1st—2nd synchronizer hub and 2nd gear wheel with synchronizer ring**

Use support 2853.

C43

**Press off 3rd—4th synchronizer hub and 3rd gear wheel.**

Use support 2853.



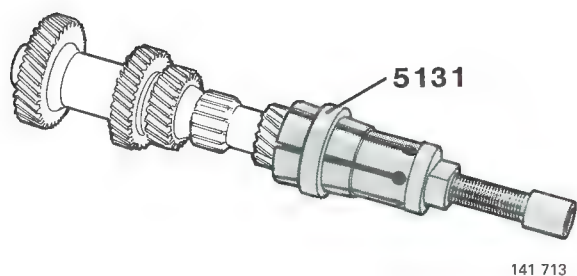
C44

**Disassemble both synchronizers**

C45

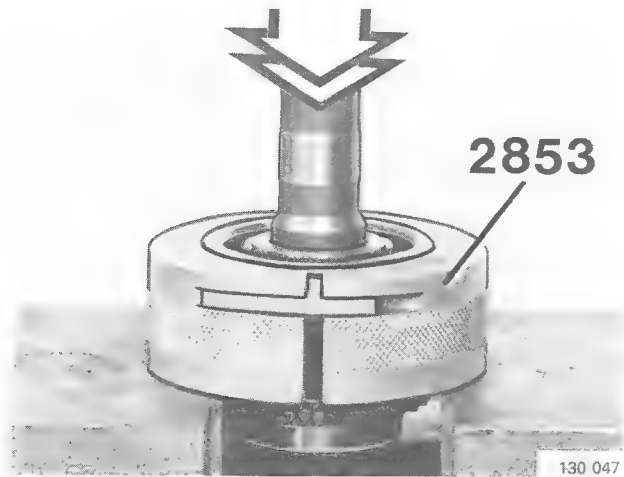
**Remove bearing on countershaft**

Use puller 5131.



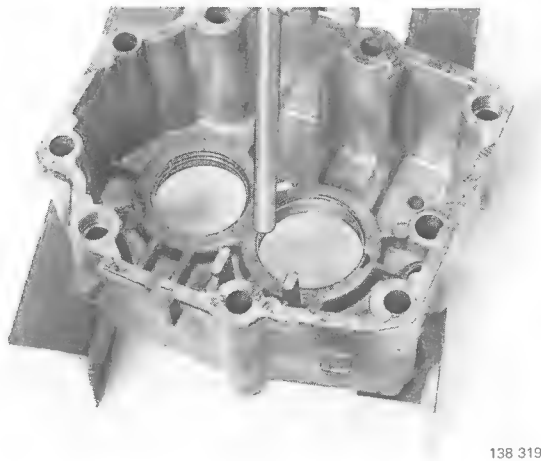


C46



**Remove input shaft bearing**

Use support 2853.



C47

**Remove bearing races from 5th gear housing**

Use brass drift.

C48

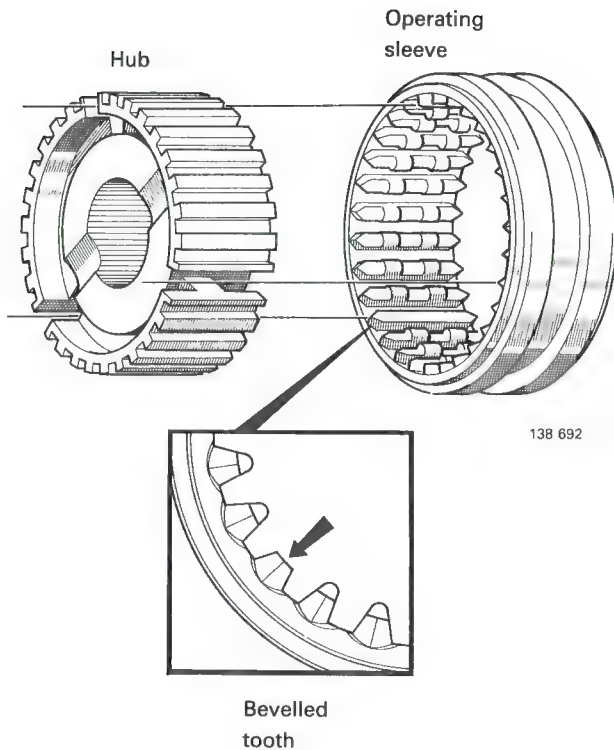
**Clean and check**

Clean all parts in solvent. Dry with compressed air.

Check all parts. Replace all worn or damaged parts and all gaskets and seals.

## D. Assembling M 47/M 47 II

Special tools: 1801, 2413, 2852, 2853, 2867, 2985, 5064, 5090, 5096, 5306, 5986, 9177

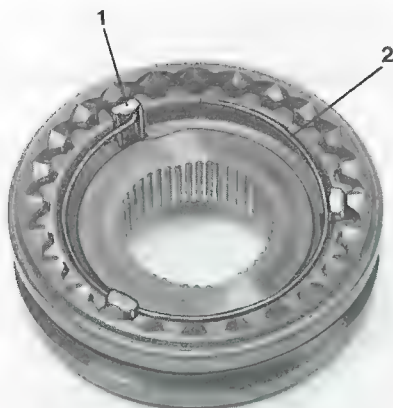


### Assembling main shaft

D1

#### Assemble both synchronizers

Place hub in operating sleeve. 3rd–4th gear synchronizer: Three recesses in hub should align with three bevelled teeth in operating sleeve.



#### Install sliding keys (1) and springs (2)

Lock sliding keys ("dogs") with springs. Hook both springs to the same sliding key.

Install one spring counter-clockwise. Turn synchronizer over and install second spring, also counter-clockwise.

If spring is bent, free end must point away from hub.

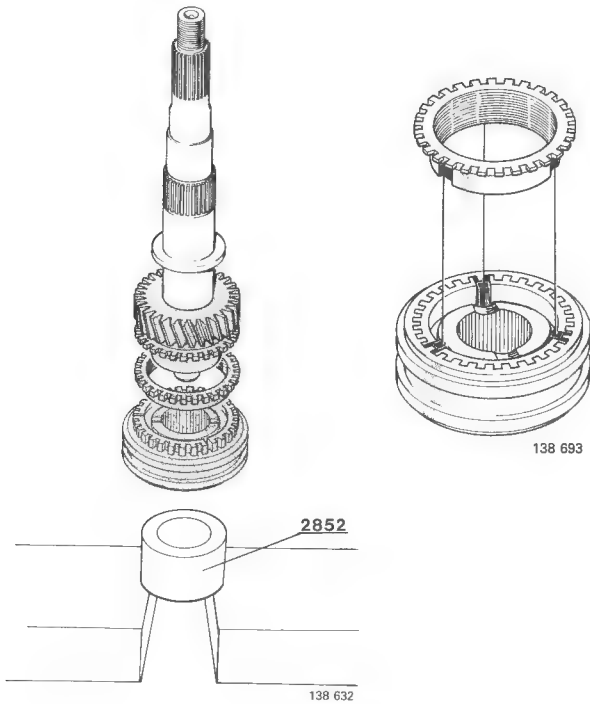
D2

D3

**Oil main shaft. Install 3rd gear wheel and synchronizer ring. Press on 3rd–4th gear synchronizer hub.**

Make sure synchronizer ring is facing correct way.

Turn wear surface on synchronizer hub UP. Use support 2852.

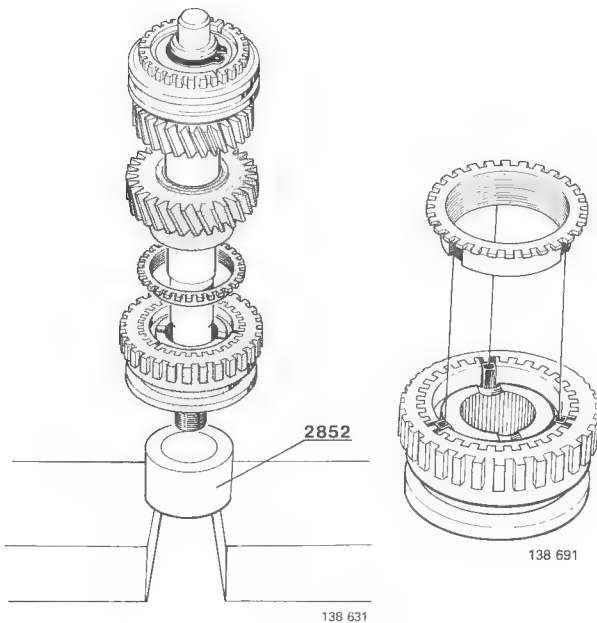


**Invert shaft**

D4

**Oil shaft. Install 2nd gear wheel and synchronizer ring. Press on 1st–2nd gear synchronizer hub.**

Make sure synchronizer ring is fitted correctly. Use support 2852.



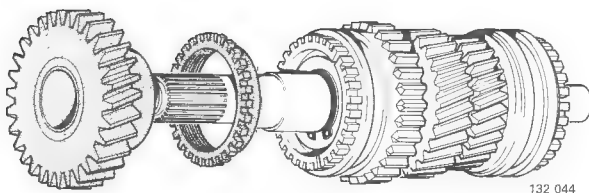
D5

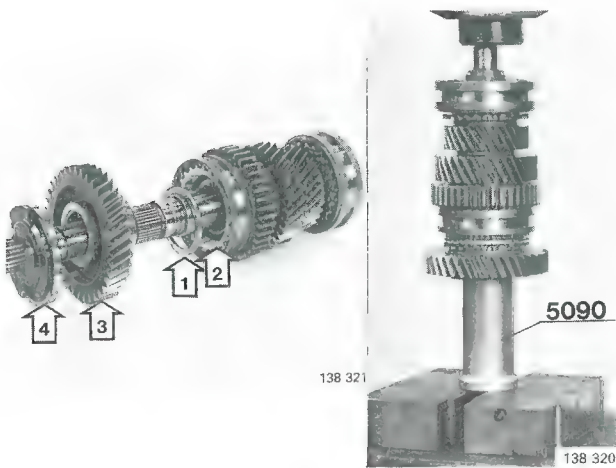
**Install lock rings for both synchronizers**

*Transmission without damper:*

D6

**Install synchronizer ring and gear wheel for 1st gear and thrust washer**





*Transmission with damper:*

**D7**

**Install thrust washer (1) if applicable, synchronizer ring (2) and 1st gear wheel (3)**

**D8**

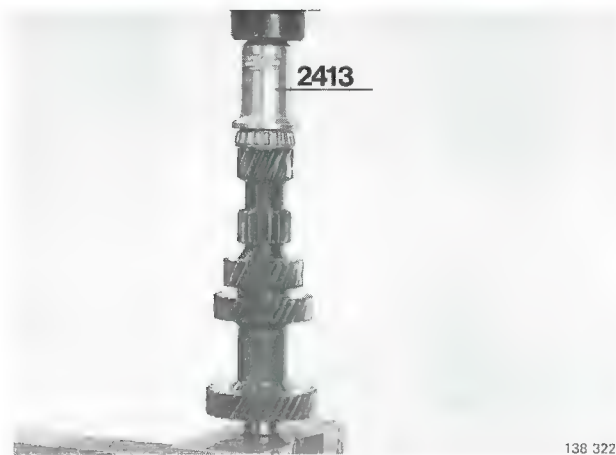
**Assemble damper**

Oil parts. Position springs in brake ring and twist washer into brake ring.

**D9**

**Press damper (4) on main shaft**

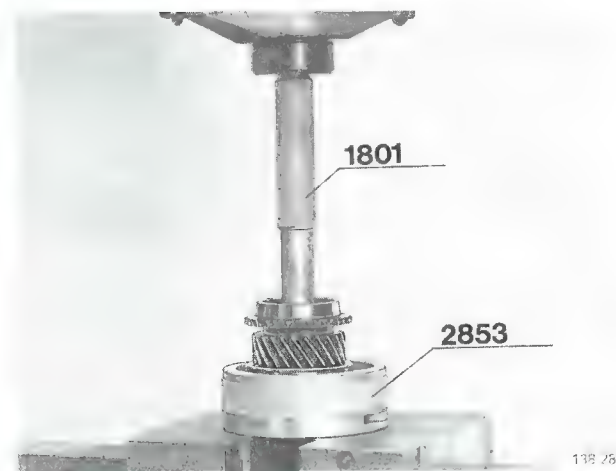
Use a file to remove sharp edges. Use 5090 to press on damper.



**D10**

**Press rear bearing on countershaft**

Use drift 2413.



**D11**

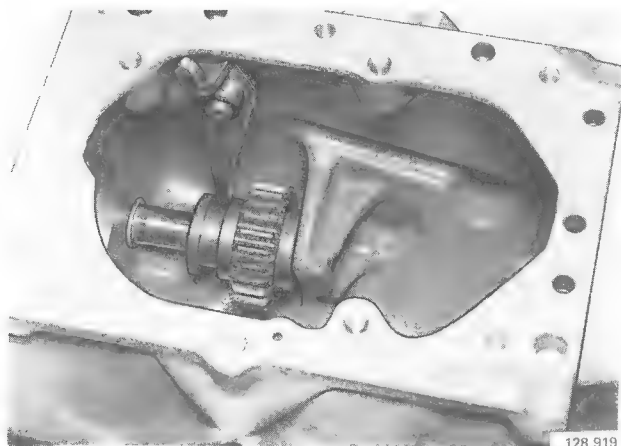
**Press bearing on input shaft**

Use standard handle 1801 and support 2853.

**D12**

**Install lock ring on input shaft**





## Installing shafts

**Note:** Apply assembly paste to aluminium surfaces prior to installing bearings and shafts.

Part Number 1 161 006-9 Aerosol  
1 161 078-9 Can

D13

### Position reverse gear shift fork

Install lock ring.

D14

### Install reverse gear and shaft

D15

### Check/adjust position of reverse gear

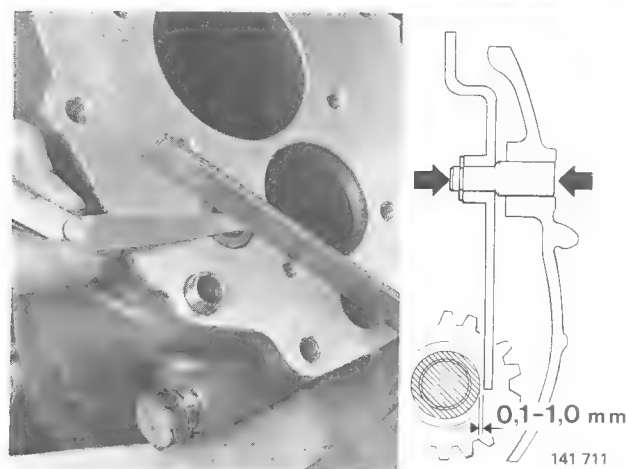
Shaft end should be flush with housing or max. 0.05 mm (0.002 in) below housing face.

D16

### Check/adjust clearance between reverse gear wheel and shift fork

Adjust by tapping shift fork bearing stud, with a drift.

Correct clearance: 0.1–1.0 mm (0.004–0.040 in).



*M 47: proceed to operation D 22.*

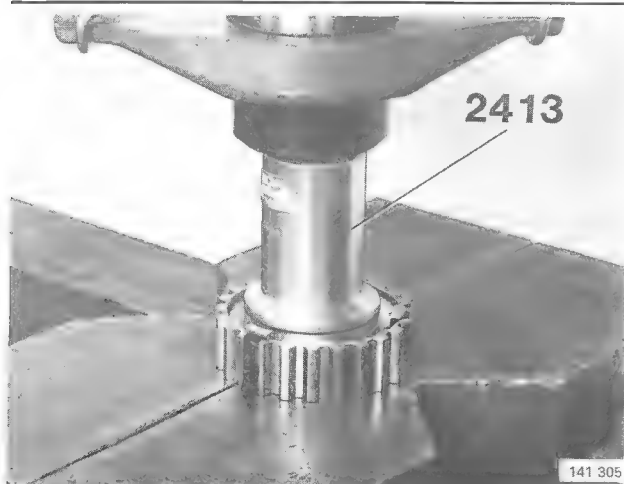
*Operations D 17 to D 21 only apply to M 47 II.*

## Assembling 5th gear synchronizer and gear wheel

D17

### Fit washer to 5th gear synchronizer hub

Use drift **2413**. First position spring counter-clockwise in hub.



D18

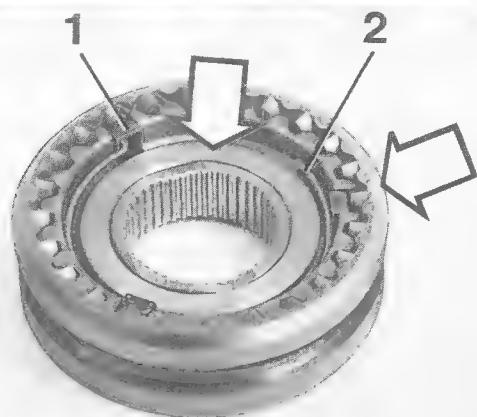
### Assemble hub and operating sleeve

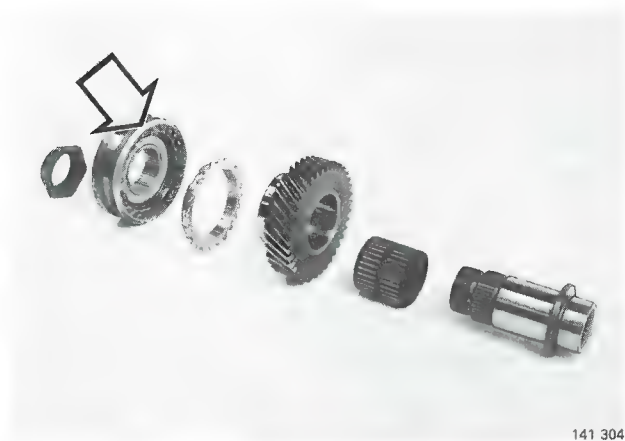
Three recesses in hub should align with three bevelled teeth in operating sleeve. Hub washer and bevelled part of operating sleeve should face same direction.

D19

### Install sliding keys (1) and spring (2)

The two springs should hook on to the same sliding key. Position spring counter-clockwise as shown in illustration.



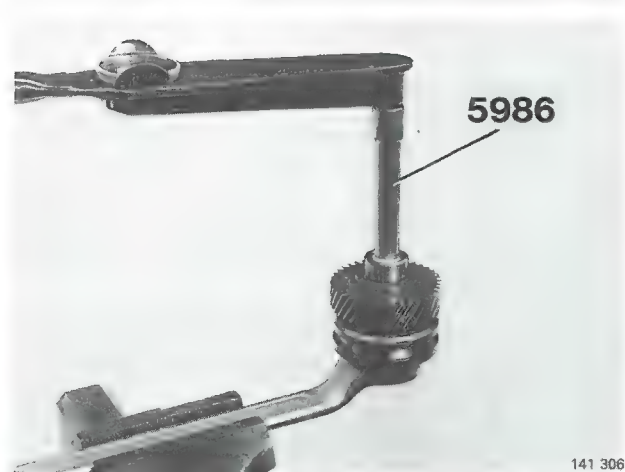


D20

### Assemble shaft, needle bearing, gear wheel and synchronizer

Bevelled edge of sleeve should face gear wheel.

Install nut finger tight.



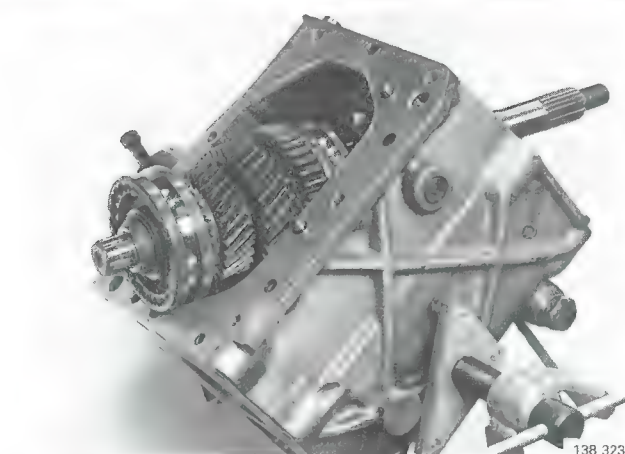
D21

### Torque nut

Clamp a 42 mm box-end wrench in a vice. Place nut in box-end wrench. Use shaft 5986 and torque wrench.

**Note:** During tightening, torque should be 40–80 Nm (30–60 ft lb). If below, replace nut.

Torque: 120 Nm (88 ft lb).



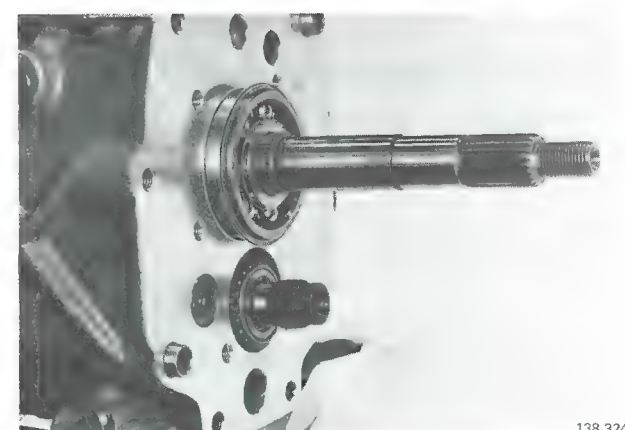
D22

### Place countershaft in bottom of housing

D23

### Place main shaft in housing

First turn housing.



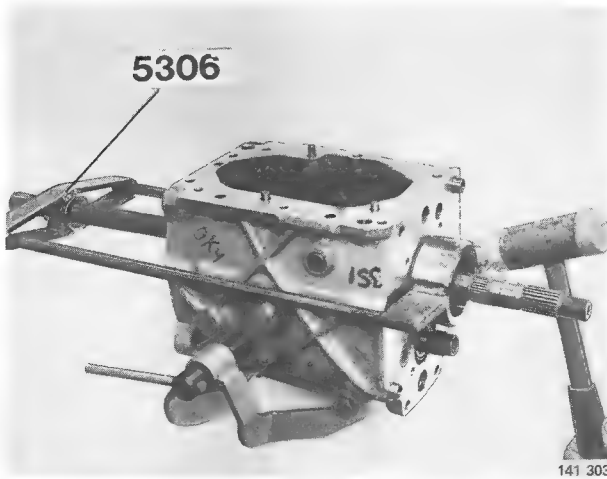
D24

### Installing rear bearing on main shaft

#### Position bearing with lock ring on main shaft

Countershaft should lie in bearing recesses.

D25

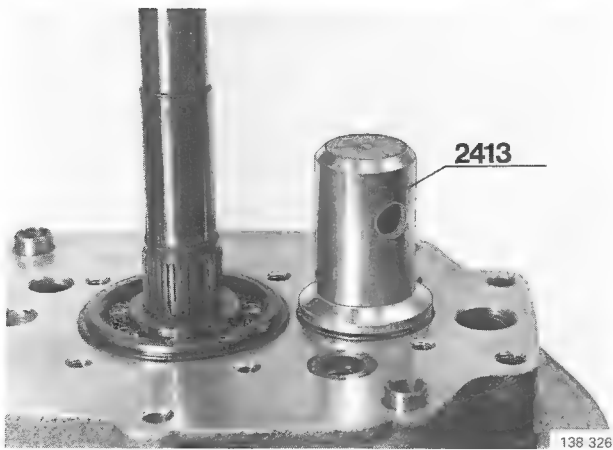
**Press main shaft bearing into position**Use press tool **5306**.

Take care not to damage gear teeth when pressing bearing into position.

D26

**Make sure bearing lock ring abuts housing**

If necessary, tap press tool with a mallet until bearing seats correctly.

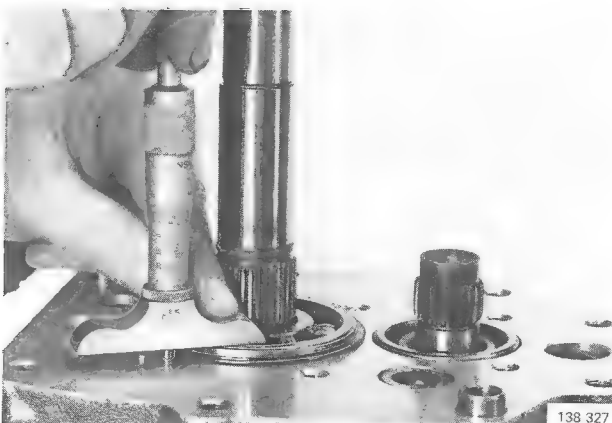


D27

**Install rear countershaft bearing race**Use drift **2413**.**Note:** Top of race must be below housing face. Race will take correct position when cage is installed.**Determining thickness of main shaft shims**

Main shaft end float should be 0.01–0.20 mm (0.0004–0.0080 in). If main shaft bearing or bearing holder has been replaced, shim thickness should be determined.

D28

**Measure distance between outer face of main shaft bearing and rear face of transmission housing**

Use depth micrometer and note reading.

## Assembling



138 328

D29

**Measure distance between bearing holder contact face and bearing seat bottom**

Note reading.

D30

**Calculate thickness of shims for main shaft**

Permitted end float: 0.01–0.20 mm (0.0004–0.0080 in).

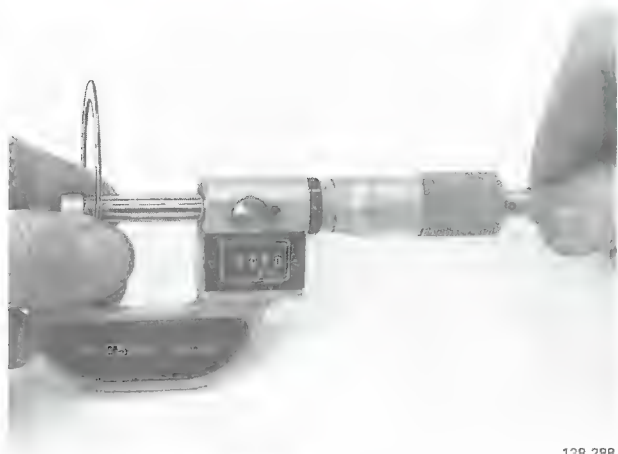
Example:

Distance:	mm	in
– Face to seat	5,50	0.2165
– Bearing to housing	–4,71	–0.1854
	=0.79	=0.0311
Deduct end float	–0.01	–0.0004
	to 0.20	to 0.0080
	= 0.59	= 0.0231
	to 0.78	to 0.0307

Select shim thickness **0,75 mm** (0.030 in)

Following shim thickness are available:

P/N	mm	in
3292838-4	0.25	0.010
948008-4	0.60	0.024
948009-6	0.75	0.030
948010-4	0.90	0.036
948011-2	1.00	0.040



138 288

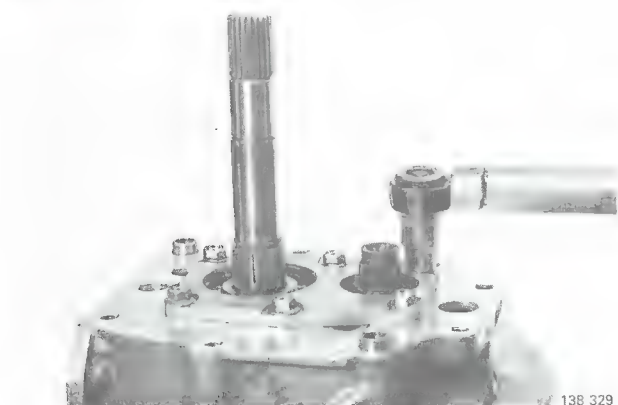
D31

**Install bearing holder**

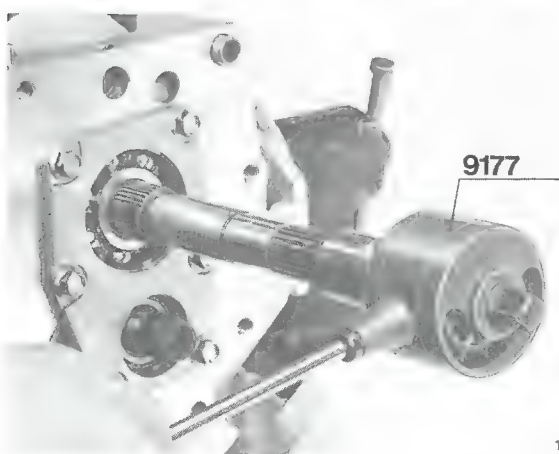
Torque to 15–25 Nm (11–20 ft lb)

**Note:** Do not interchange short bolts with long cover bolts

Tap bearing holder to seat bearing races.



138 329



138 330

*Transmissions with damper:*

D32

**Check torque for output shaft**

Use torque gauge **9177** and hold 1st gear wheel by hand.

Correct torque: **0.8–2.5 Nm** (7–22 in lb)

**M 47 II:** Proceed to operation D 37.



Operations D33 to D36 only refer to M 47.

## Installing 5th gear synchronizer hub Calculating shim thickness

Adjust bearing position to obtain a clearance of max 0.20 mm (0.008 in) to lock ring.

**D33**

Install original shim, as applicable

**D35**

Install lock ring

**D36**

## Measure clearance between lock ring and hub

If clearance exceeds **0,20 mm, (0.008 in)**, remove hub and install shim.

### Example:

Distance hub to lock ring : 0.25 mm (0.010 in)

Select shim thickness 0.15 mm (0.006 in)

Following shims are available:

P/N	mm	in
34615-5	0.10	0.004
120116-9	0.15	0.006
34614-8	0.35	0.014
947120-2	0.50	0.020

Proceed to operation D38.

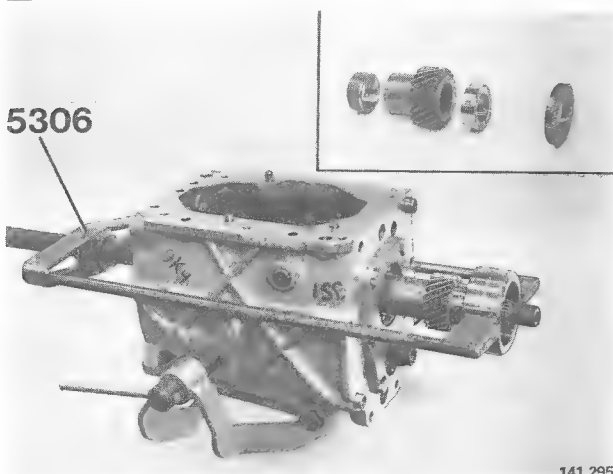
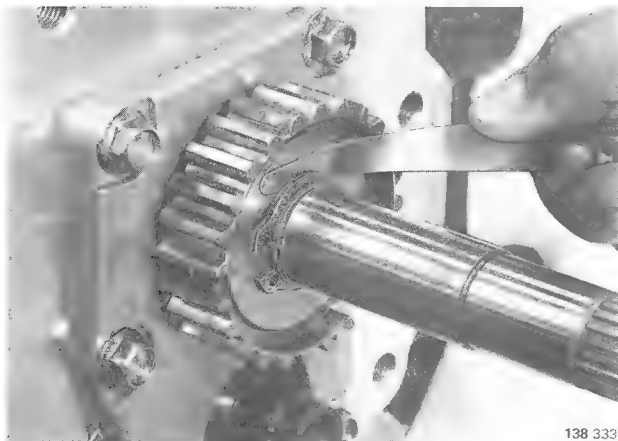
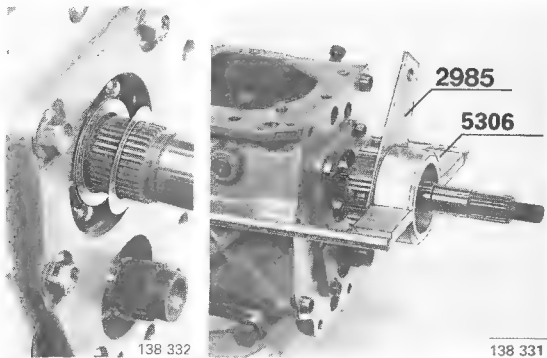
Operation D37 only applies to M 47 II.

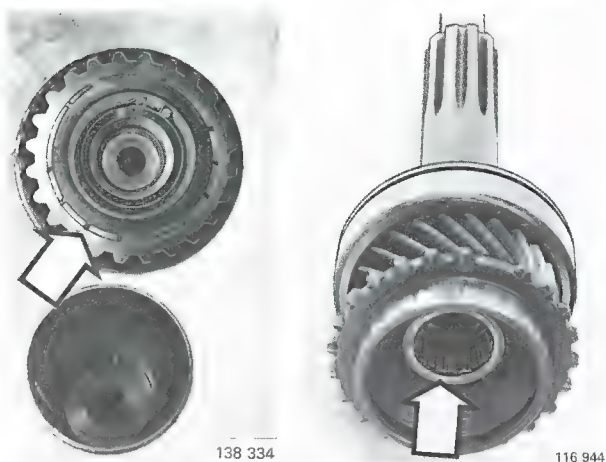
## Installing 5th gear wheel

**D37**

Press on spacer washer, 5th gear wheel and bearing race

Use press tool **5306** with thrust washer as support.





## Installing input shaft

D38

Position 4th gear synchronizer ring in synchronizer hub

D39

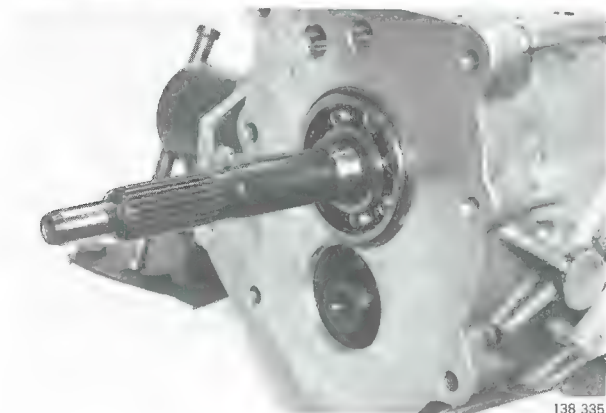
Grease and install roller bearing in input shaft

D40

## Install input shaft, lift countershaft

Tap bearing with a plastic mallet if it is difficult to move it.

Lift intermediate shaft before positioning input shaft.



D41

## Install front countershaft bearing

Use drift 2413.



M 47 II; Proceed to operation D 45.

Operations D42 to D44 only refer to M47.

## Assembling 5th gear synchronizer, M 47

D42

Install 3 sliding keys

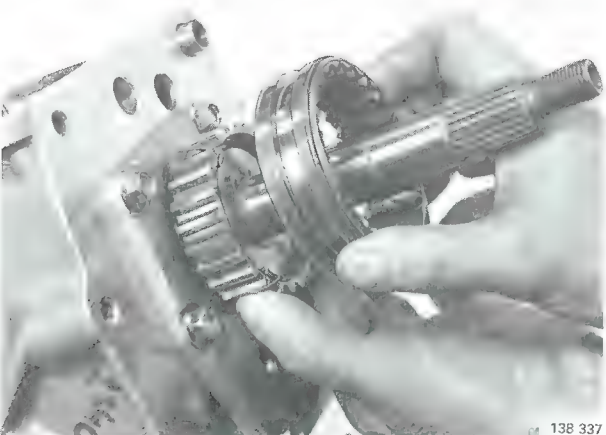
D43

Position sleeve so that bevelled teeth align with sliding keys

D44

Install spring

Proceed to operation D47.



*Operations D 45 to D 46 only refer to M 47 II*

## Installing 5th gear and synchronizer, M 47 II

*D45*

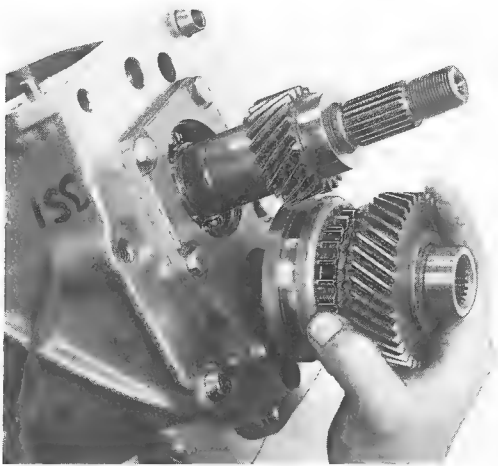
### Install 5th gear synchronizer and gear wheel on countershaft

First pull out operating sleeve so that half of hub becomes visible. Then install synchronizer and gear wheel on countershaft.

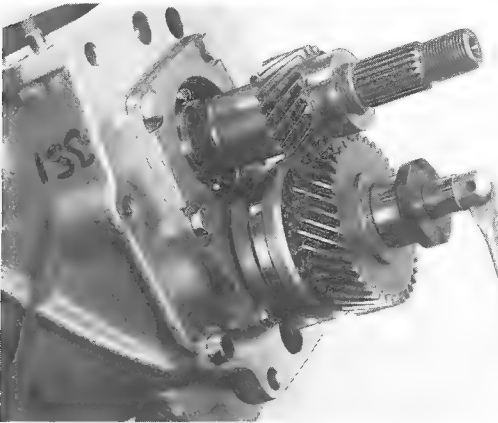
*D46*

### Press on synchronizer and gear wheel

Install bolt and washer. Tighten until bolt bottoms.



141 302

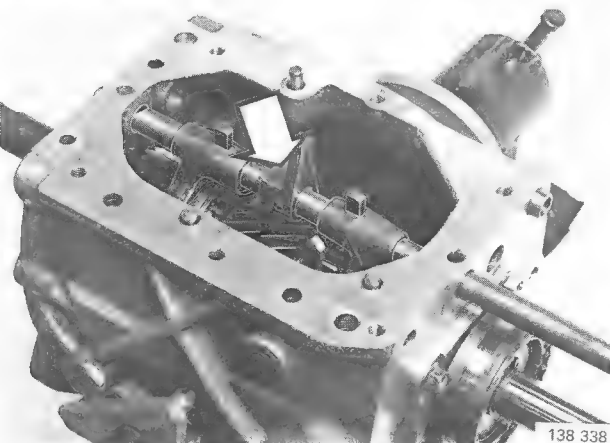


141 301

*D47*

### Install 1st—2nd and 3rd—4th gear selector fork, gear selector and selector shaft

Make sure sliding lugs are positioned correctly. Gear selector lug should face forwards.

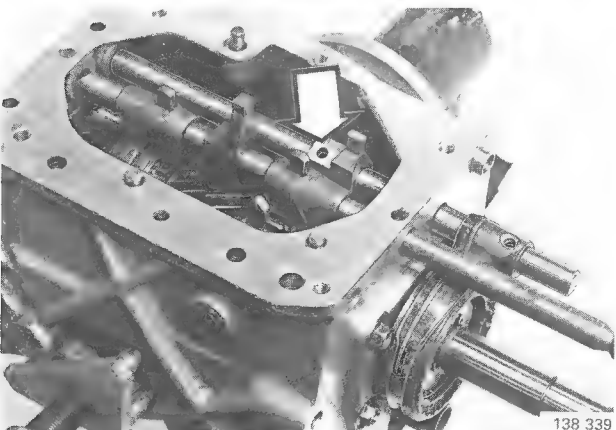


138 338

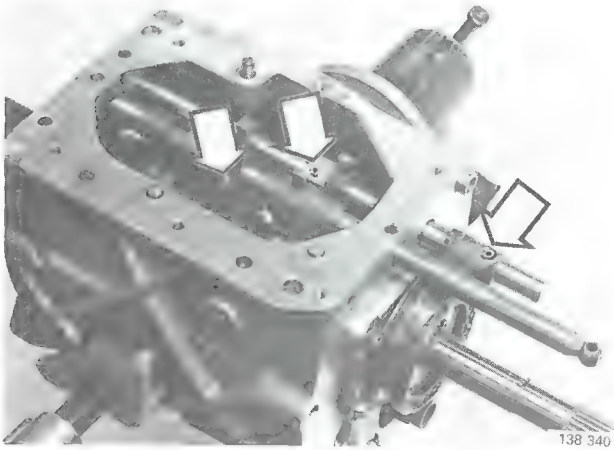
*D48*

### Install 5th gear shift fork, gear selector and selector shaft

Gear selector lug should face forwards.



138 339



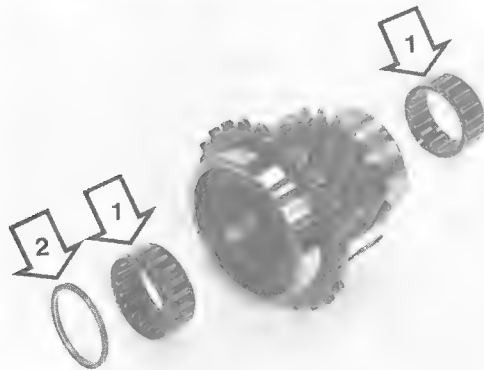
D49

### Install locking pins (3 ×)

Grooves in selector shaft should face UP.

Pin in 5th gear shift fork should be flush with surface.  
Support 5th gear selector shaft when tapping pins into position.

*M 47 II: Proceed to operation D 53.*



138 341

### Installing 5th gear wheel, M 47

D50

Grease and install two needle bearings (1) and spacer (2) in 5th gear wheel

D51

Install synchronizer ring on synchronizer hub

D52

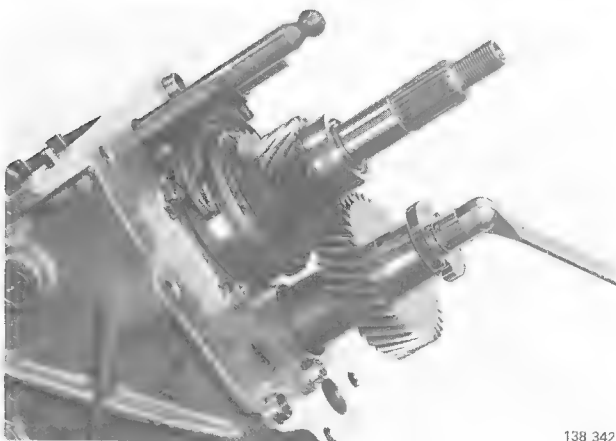
### Install both gear wheels

Install bolt and washer on countershaft.

Pull bolt to press on large gear wheel.

Make sure large gear wheel is correctly positioned.

Remove bolt and washer.

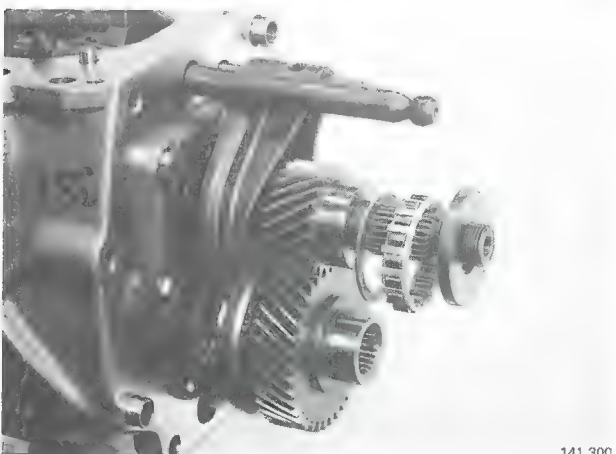


138 342

D53

### Install washer, roller bearing and thrust washer

Enclosed side of bearing should face rearwards.



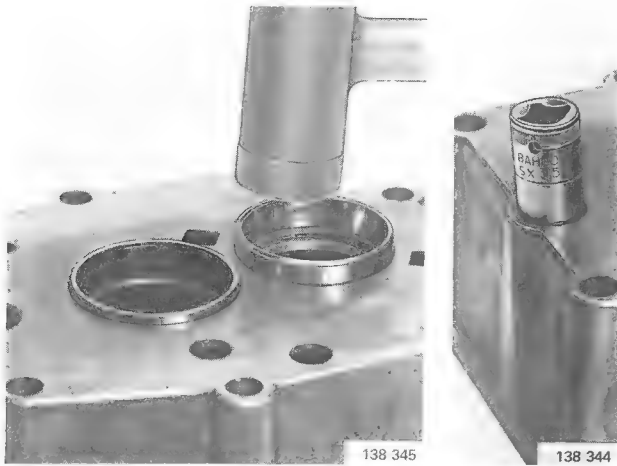
141 300



D54

**Install bearing races and selector shaft seal in 5th gear housing**

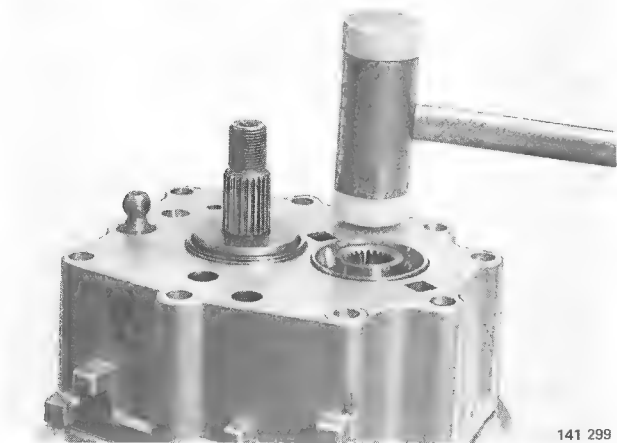
Tap bearing races into position with a plastic mallet. Use a socket to install selector shaft seal.



D55

**Grease contact face, position gasket and install 5th gear housing**

Carefully tap 5th gear housing into position.

**Determining countershaft shim thickness**

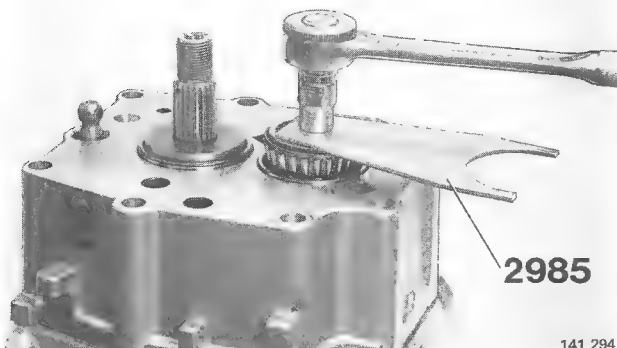
Countershaft should have an end float of 0.01–0.10 mm (0.0004–0.0040 in). If countershaft, any of its bearings, or the rear case/intermediate housing have been replaced the shim thickness must be determined.

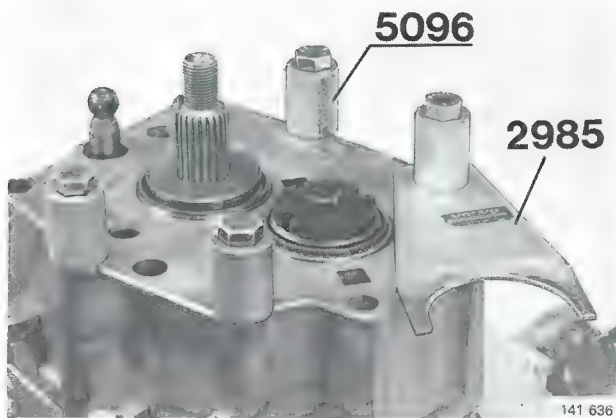
D56

**Install rear countershaft bearing M 47 II:**

Place support 2985 under nut when pressing bearing into position. Then install correct washer with old shim pack and tighten bearing to bottom.

**Note:** Make sure washer teeth align with gear teeth.





D57

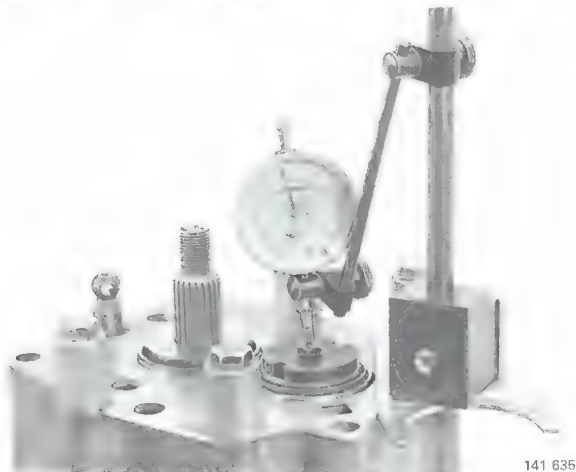
**Attach 5th gear housing**

Use shift bracket bolts and 4 × **5096** (B28-tools) as spacers.

D58

**Install support 2985 on one of the bolts**

Torque bolts to 35–50 Nm (26–37 ft lb).

**Position dial indicator**

D59

**Push up and turn shaft to set front bearing. Calibrate dial indicator zero**

D60

**Lower and turn shaft to set rear bearing. Read dial indicator**

Note reading.

(If no play exists, select thinner shim.)

D61

**Calculate thickness of countershaft shim**

Permitted end float: **0.01–0.10 mm. (0.004–0.0040 in).**

Example:	mm	in
Measured clearance	0.25	0.0098
Existing shim pack	+0.55	+0.0220
Total clearance	= 0.80	= 0.0318
Deduct end float	–0.01 to 0.10	–0.0004 to 0.0040
Shim thickness	= 0.70 to 0.79	= 0.0278 to 0.0314

Select shim thickness 0.75 mm (0.030 in).

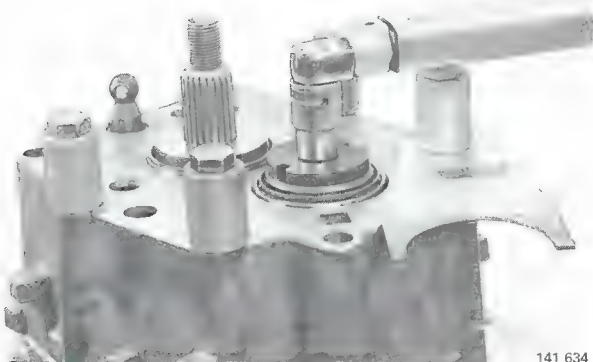
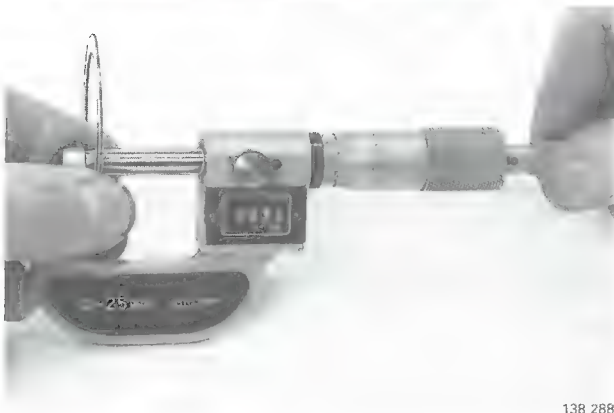
Following shim thicknesses are available

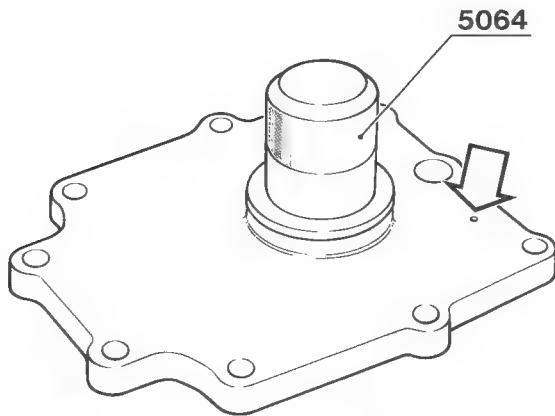
P/N	mm	in
3294334-2	0.10	0.004
3294335-9	0.15	0.006
3294336-7	0.25	0.010
3204069-3	0.55	0.022
3204070-1	0.75	0.030

D62

**Install new shim pack, washer and a new self-locking bolt, or use thread locking compound 1161053-2**

Engage two gears to lock transmission. Torque to: 35–45 Nm (25–32 ft lb).





## Installing rear end cover

D63

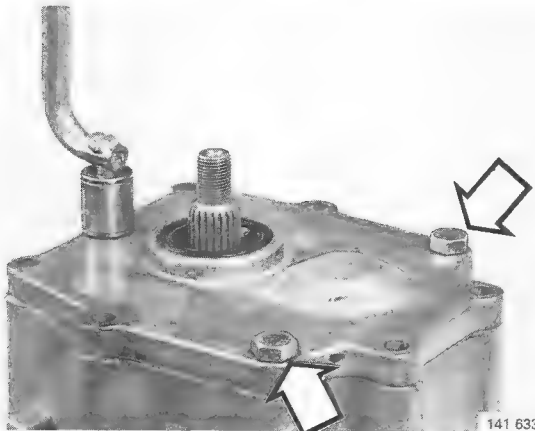
**Make sure vent hole is not blocked**

D64

### Install seal in rear end cover

Grease and install output shaft seal. Use drift **5064**.

Seal should be positioned **2,5 mm** (0.1 in) inside flange.



D65

**Grease housing face and position gasket**

D66

**Use two bolts to attach rear end cover**

D67

### Attach gear selector rod

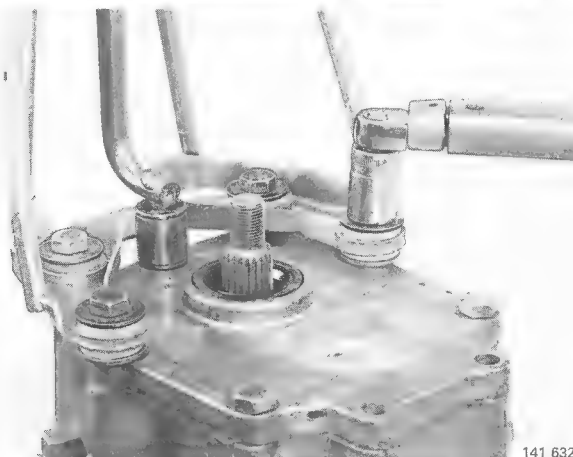
Grease and install rubber ring in joint. Use sleeve to lock pins.

D68

### Install selector bracket

**Note:** Bolt – washer – spacer tube – washer.

Torque bolts to 35–50 Nm (25–35 ft lb).



D69

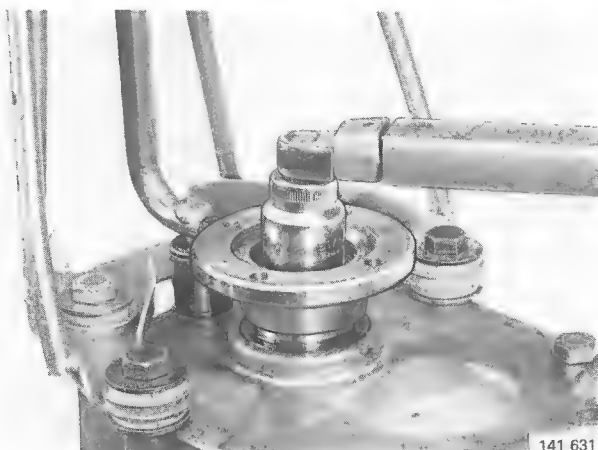
### Install drive flange

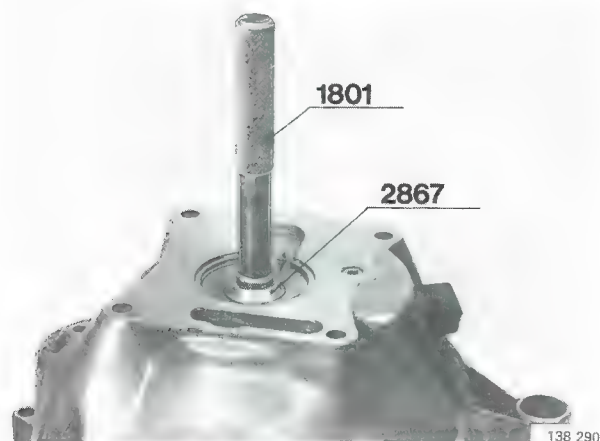
Torque nut to:

Bolt M16 ..... **70–90 Nm** (50–60 ft lb)

Bolt M20 ..... **90–110 Nm** (65–80 ft lb)

Engage two gears to lock transmission.





D70

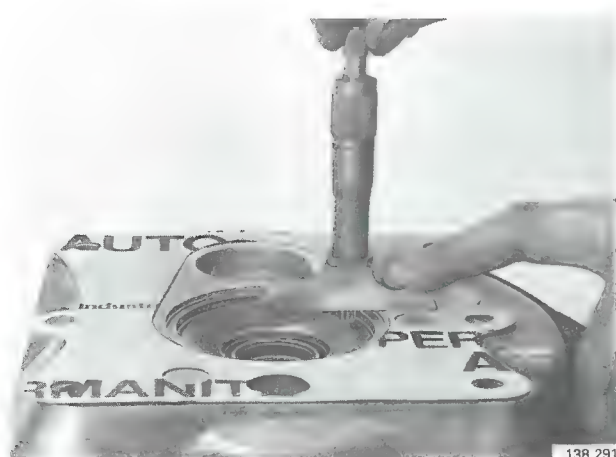
### Grease and install seal in bell housing

Make sure pipe is at bottom.

Use drift **2867** and standard handle **1801**.

### Determining input shaft shim thickness

Permitted end float: **0.01–0.20 mm.** (0.0004–0.0080 in). If input shaft, bearing on input shaft, or clutch housing has been replaced, shim thickness must be determined.



D71

### Position gasket on clutch housing

D72

### Measure distance between gasket top and bearing seat bottom

Note distance



D73

### Make sure bearing spacer washer abuts housing

D74

### Measure distance between upper face of input shaft bearing and front face of transmission housing

Use depth micrometer and note reading.



D75

**Calculate input shaft shim thickness**

Permitted end float: **0.01–0.20 mm.** (0.0004–0.0080 in).

**Example:**

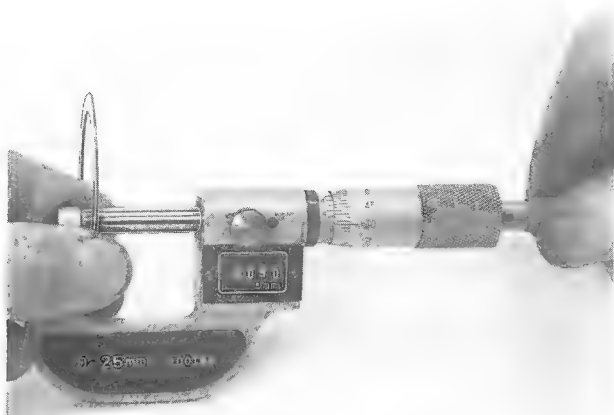
Distance:	mm	in
– gasket face to bearing seat	5.80	0.2283
– bearing to housing	–4.85	–0.1909
	=0.95	=0.0374
Deduct end float	–0.01	–0.0004
	to 0.20	to 0.0080

Calculated shim thickness	=0.75	=0.0294
	to 0.94	to 0.0370

Select shim thickness **0.90 mm.** (0.036 in).

Following shim thicknesses are available:

P/N	mm	in
3292838-4	0.25	0.010
948008-8	0.60	0.024
948009-6	0.75	0.030
948010-4	0.90	0.036
948011-2	1.00	0.040



138 288

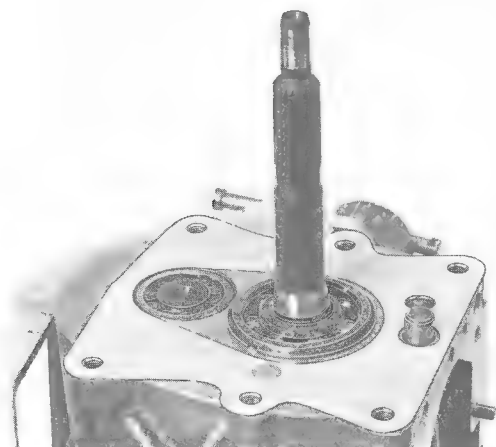
D76

**Grease transmission gasket face and position gasket**

D77

**Position shim in clutch housing**

Apply grease to hold shim in position.



138 354

D78

**Install bell housing**

Torque to **35–50 Nm** (25–35 ft lb).

D79

**Install clutch release fork, washer and release bearing**

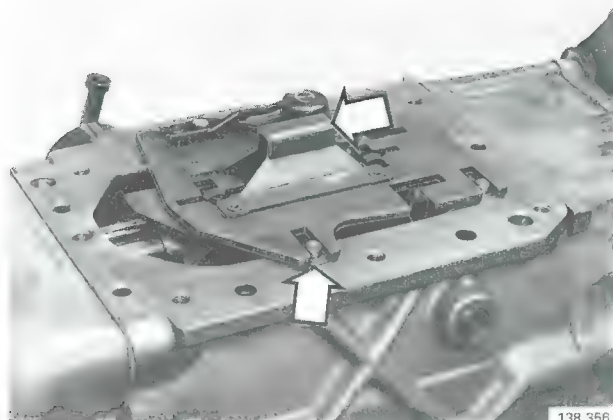
First apply grease to bearing sliding surface and ball joint.

**Sparingly apply grease to splines.**

Do not forget to place washer beneath ball

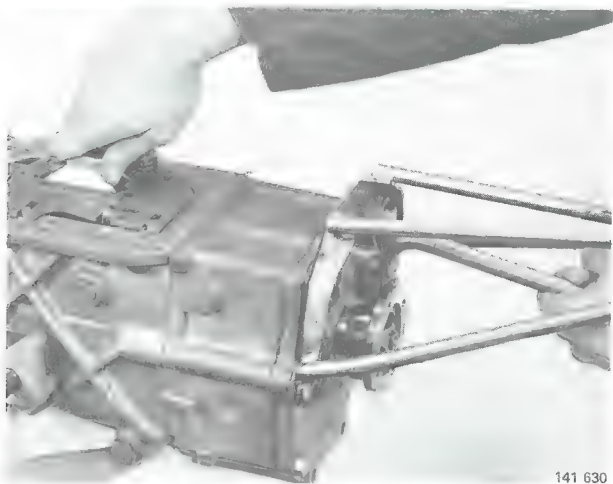


138 355



D80

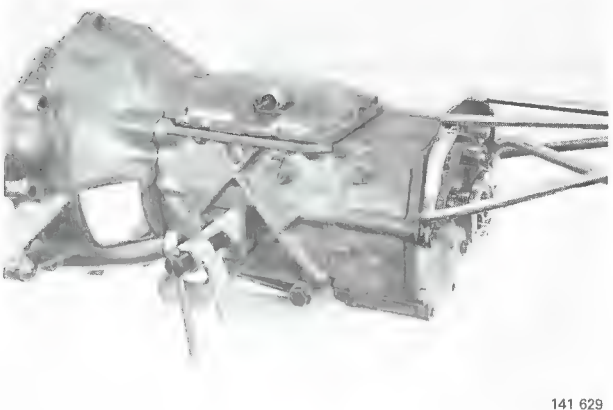
**Install sliding washers and selector plate**



D81

**Check function**

Move selector plate by hand to check that all gears can be engaged and disengaged.



D82

**Install interlock ball and spring**

D83

**Grease housing face and position gasket**

D84

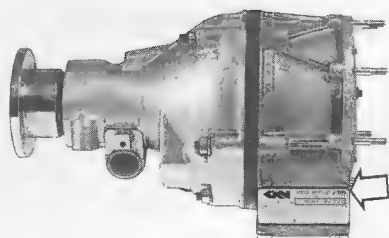
**Install transmission cover**

Torque bolts to 15–25 Nm (11–20 ft lb).

## E. Disassembling Type J and Type P, overdrives

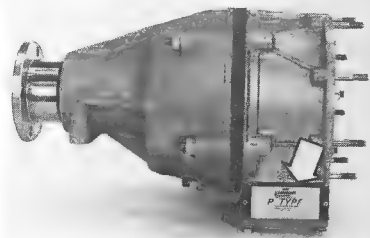
Special tools: 2836, 5069, 5103, 5149, 5172,  
5183, 5210, 5303, 5304, 5973,

Type J



141 607

Type P



141 162

### Disassembling

E1

**Clamp overdrive rear end in a vice protected by soft jaws**

E2

**Remove solenoid valve**

Use crow-foot wrench **5172**. Disconnect ground wire.

E3

**Remove:**

- bridges.
- front and rear housing nuts

**Note:** Last two nuts removed should be opposite each other. Loosen the nuts stepwise.

E4

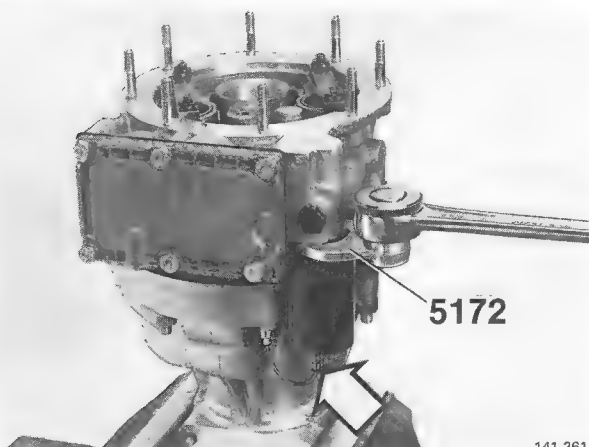
**Remove front housing assembly**

E5

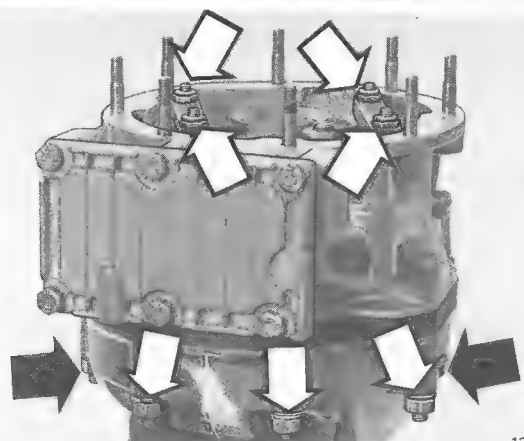
**Remove:**

- brake drum
- springs. Lift out clutch, thrust bearing and sun gear assembly.

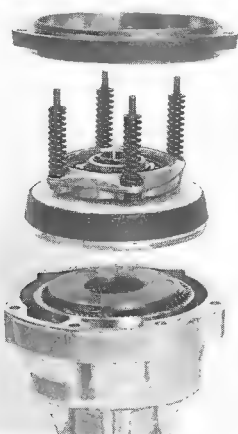
*Type P: Proceed to operation E7.*



141 261

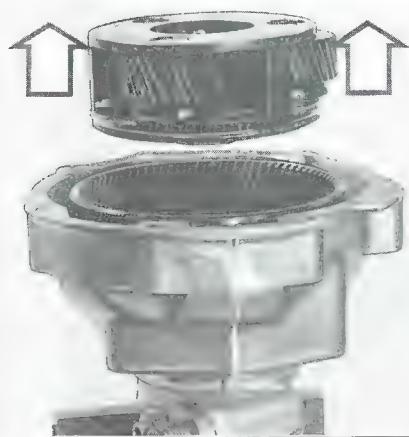


135 198



141 260

Disassembling



134 335

*Operation E6 only applies to Type J. Overdrive.*

**E6**

**Remove planetary gear assembly**

Replace planetary gear assembly if gears or carrier are damaged.

*Proceed to operation E9.*



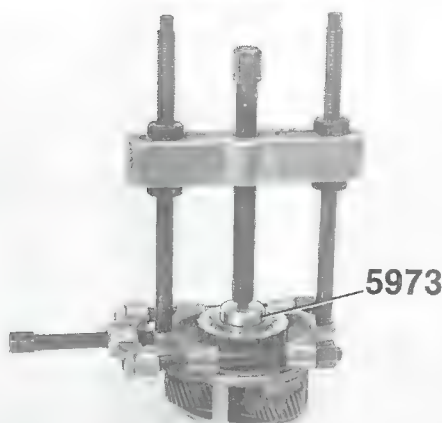
141 259

*Operations E7 to E8 only refer to Type P Overdrive.*

**E7**

**Remove:**

- planetary gear carrier
- thrust washer



141 258

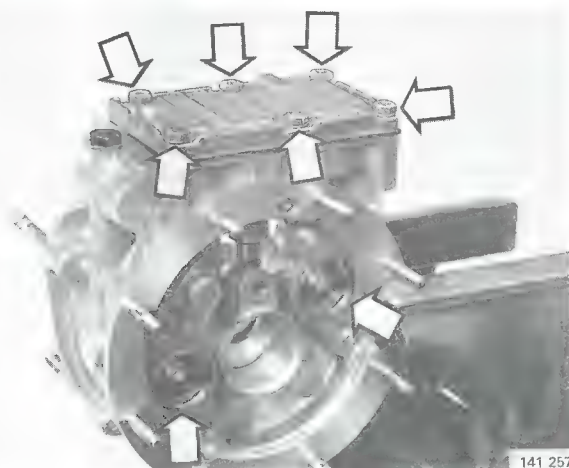
If one-way clutch or planetary gear carrier is to be replaced:

**E8**

**Pull off one-way clutch from planetary gear carrier**

Use universal type puller.  
Place washer **5973** under puller spindle.

Replace planetary gear assembly if damaged



141 257

**Disassembling front housing**

**E9**

**Clamp overdrive front part in a vice protected by soft jaws**

**E10**

**Remove:**

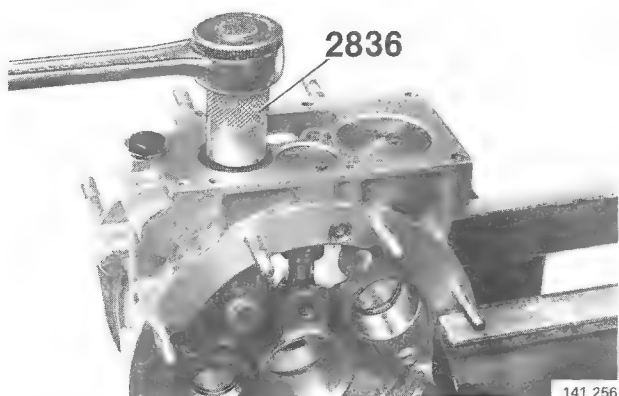
- oil pan and strainer
- pistons. Use pliers.



E11

**Remove oil filter plugs, check valve and relief valve**

Use plug wrench **2836**. Tap plugs with a plastic mallet to facilitate removal.

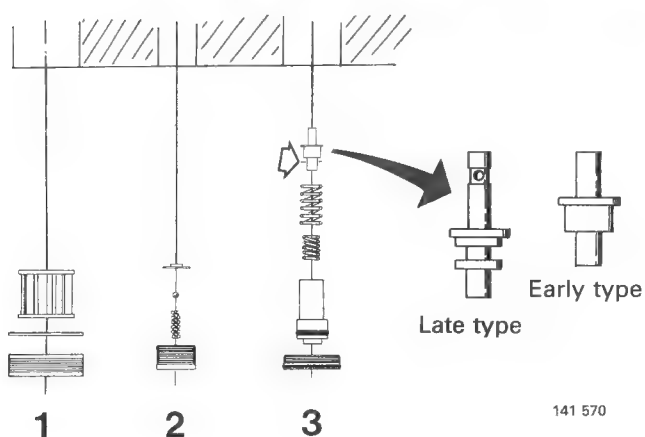


E12

**Remove:**

1. Oil filter
2. Check valve and spring, ball and seat
3. Relief valve assembly. (If replacing, always use new type relief valve).

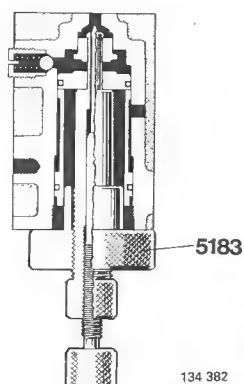
Examine relief valve piston. If scored, it will damage O-ring. Replace relief valve assembly.



E13

**Withdraw cylinder and relief valve seat**

Use extractor **5183**.

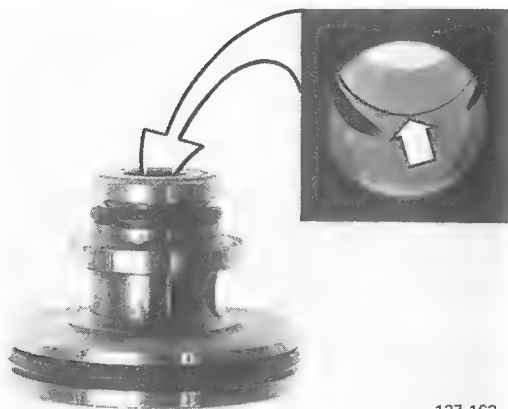


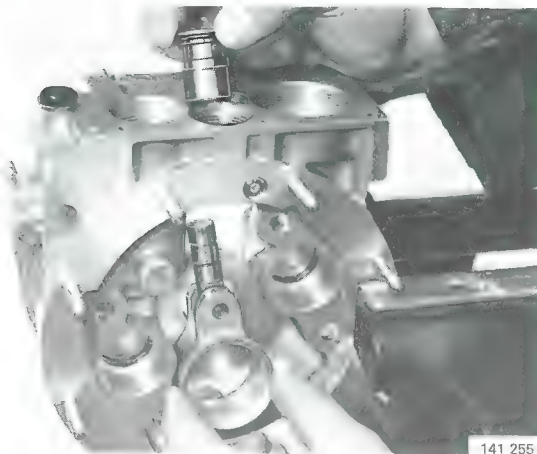
E14

**Examine relief valve**

If engagement valve is slow or if overdrive slips on engagement, it is particularly important to check following.

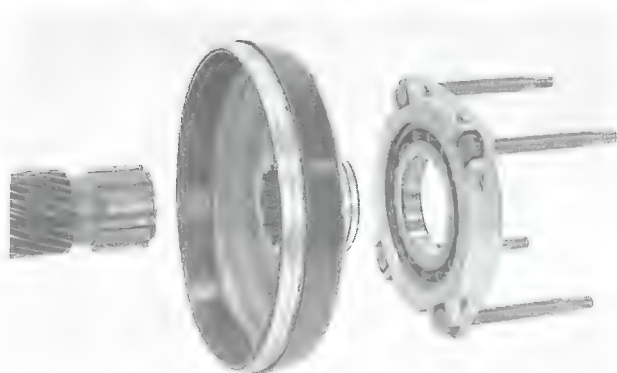
Check valve seat. If there are signs of wear, replace relief valve assembly.





E15

**Remove cylinder and pump piston**



E16

**Remove lock ring. Pull out sun gear and clutch disc from bearing carrier**



E17

**Remove lock ring. Tap out bearing from carrier.**  
Use drift 5103.

*Type P: Proceed to operation E22.*

*Operations E18 to E21 only refer to Type J.*

## **Disassembling rear housing. Type J Overdrives**

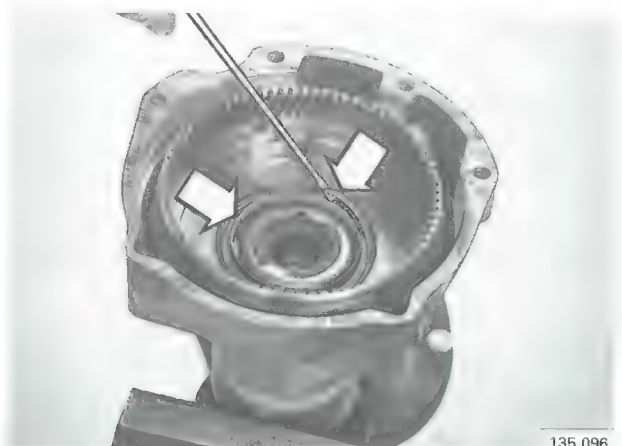
E18

**Clamp overdrive rear housing in a vice protected by soft jaws**

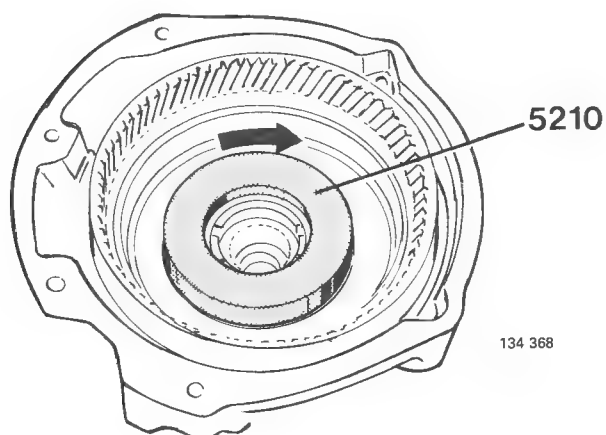
E19

**Remove lock ring and one-way clutch oil slinger**

**Note:** Turn one-way clutch in locking direction and make sure that outer ring does not slip on input shaft.

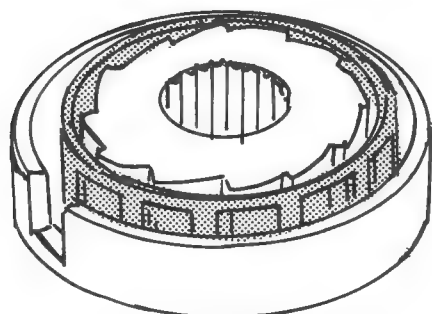


E20

**Remove one-way clutch**

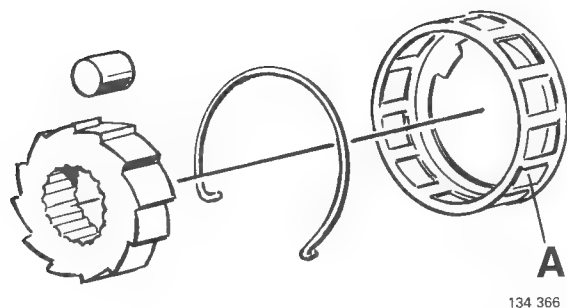
Use ring 5210. Turn ring clockwise

E21

**Examine roller cage**

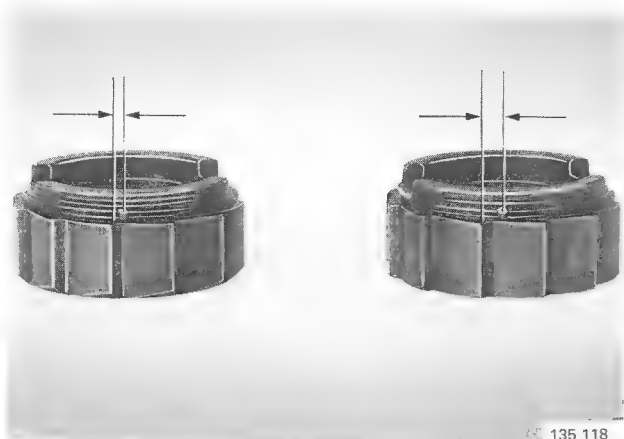
Invert ring with one-way clutch in it. Check to see if roller cage is oval. If so, replace with new type, Volvo P/N 1 209 726-7.

E22

**Disassemble one way clutch**

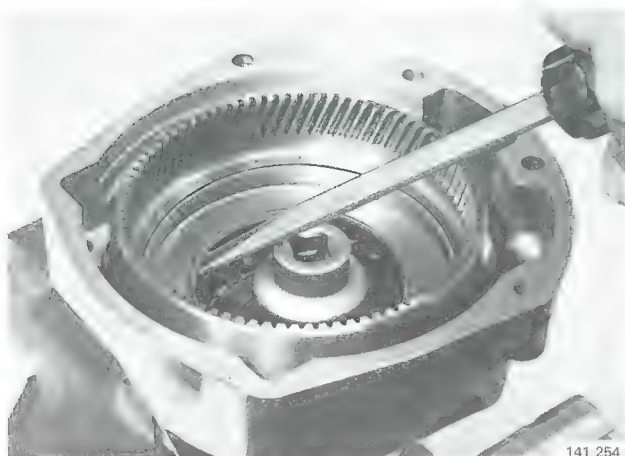
**Note** Illustrations show an early version of one-way clutch.

Replace any damaged parts.



If early type one-way clutch is fitted, replace it with new type: Volvo P/N 1 209 484-3. (Location of lock spring hole is new.) See illustration.

**Proceed to operation E26**



141 254

Operations E 22 to E 25 only refer to Type P.

## Disassembling rear housing, Type P, Overdrive

Clamp overdrive rear housing in a vice protected by soft jaws

E23

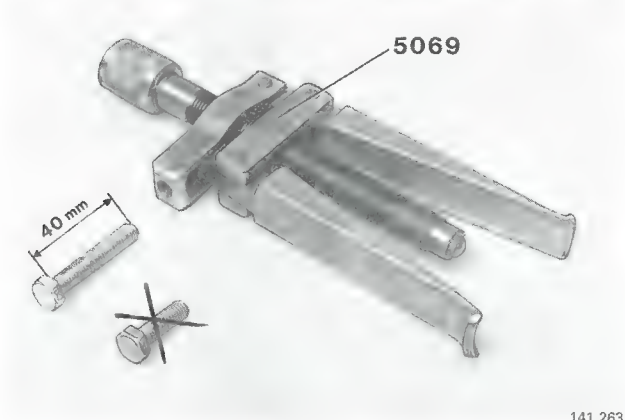
Pry up oil slinger in two places to install puller 5069.

Place a socket on hub. Use a screwdriver to pry up oil slinger.

E24

### Modification to tool 5069

Replace center bolt with a 40 mm long bolt, threaded along entire length. P/N 998 9709.

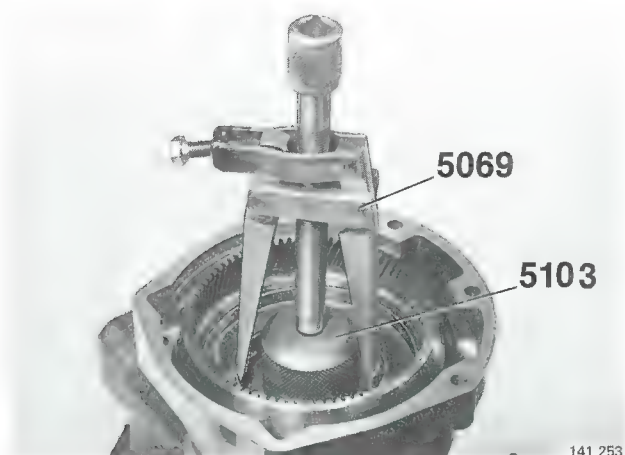


141 263

E25

Place drift 5103 (group 21 tool) in bottom of housing. Use puller 5069 to draw out oil slinger.

Remove roller cage.



141 253

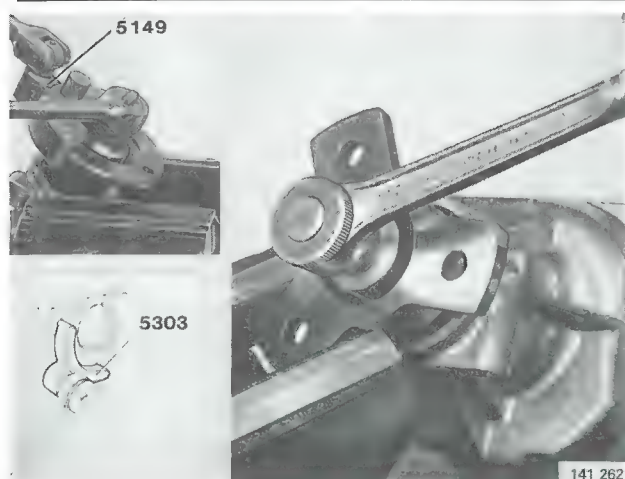
E26

### Remove drive flange nut

Round drive flange: Use wrench 5149 to hold.

Three-arm drive flange: Clamp drive flange in a vice.

**Note:** Use wrench 5303 when removing drive flange from vehicle.



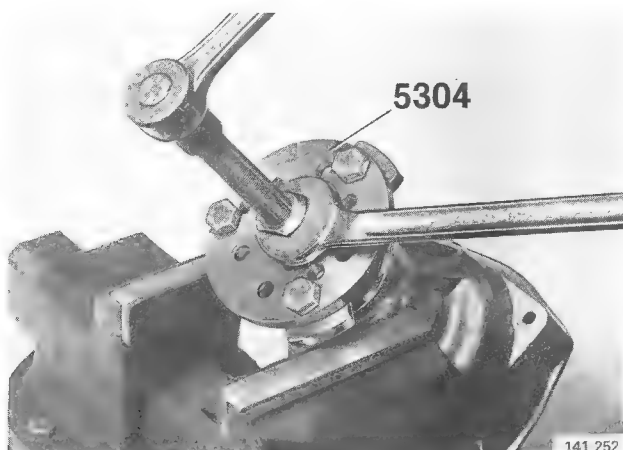
141 262



E27

**Withdraw drive flange**

Use puller **5304** if required.



E28

**Remove oil seal with puller 5069.**



E29

**Press out output shaft**

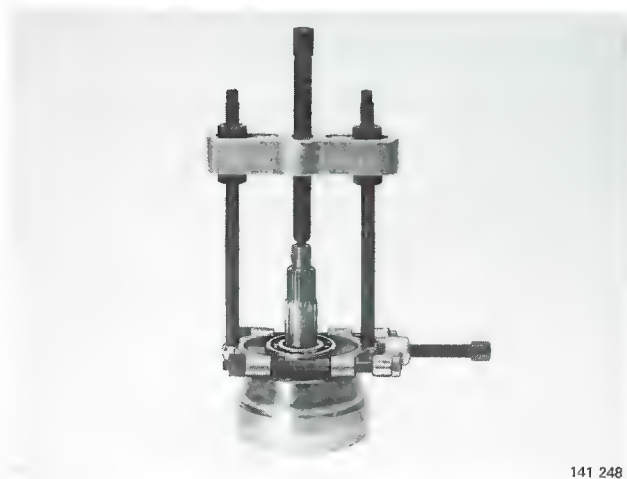


E30

**Remove spacer sleeve**

(On Type J: speedometer drive gear.)





141 248

**Withdraw output shaft bearing**

*E31*



141 247

**Tap out bearing from rear housing**

(Only if bearing is to be replaced.) Use brass drift.

*E32*

## F. Examining overdrive

### *Cleaning and checking*

#### **Check:**

- that control orifice drilling between relief valve and solenoid is free from dirt. If it is not possible to blow-clean, use a pointed matchstick. Do not attempt to clean the orifice with wire or its calibration may be impaired.
- that groove in front of ring gear in output shaft is thoroughly clean. (Dirt collects here as a result of centrifugal force.) Clean all parts and check carefully for signs of wear, cracks or other damage. Check following carefully:
  - that filter is undamaged
  - operating pistons for scores or wear
  - valves for wear
  - all gear wheels and bearings for cracks and wear.

#### **Check:**

- that clutch return spring is  $55.5 \pm 1.5$  mm (2.1852 0.060 in) long
- that springs are not misshaped or cracked
- brake ring for cracks, scores, wear etc.
- cone clutch for signs of burning or wear
- solenoid by means of a 12 volt battery and an Ammeter. Power consumption = 1.5–2.0A. Check movement of solenoid plunger.

## G. Assembling Type J and Type P overdrives

*Special tools: 1845, 2412, 2806, 2834, 2835, 2836, 5149, 5172, 5210, 5308*

Use new gaskets, O-rings and seals when assembling overdrive. Observe utmost cleanliness since the hydraulic system is very sensitive to dirt.



### Assembling rear housing

G1

#### Press bearing in rear housing

Use drift 2412.



G2

#### Press on bearing on output shaft

Use drift 2412.



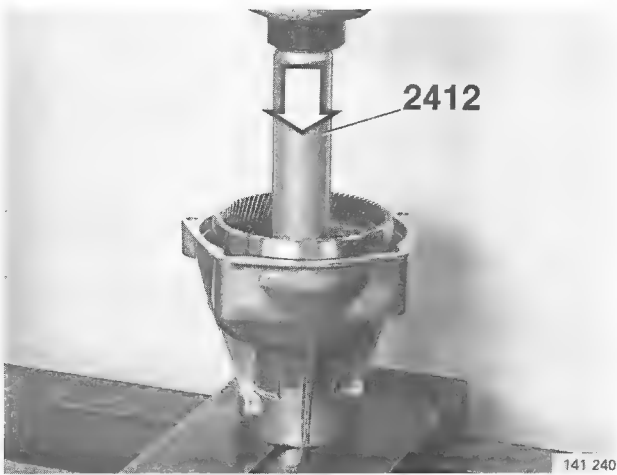
G3

#### Install spacer sleeve on output shaft

(On Type J: speedometer drive gear.)



G4



**Press output shaft in rear housing**

Use drift 2412.

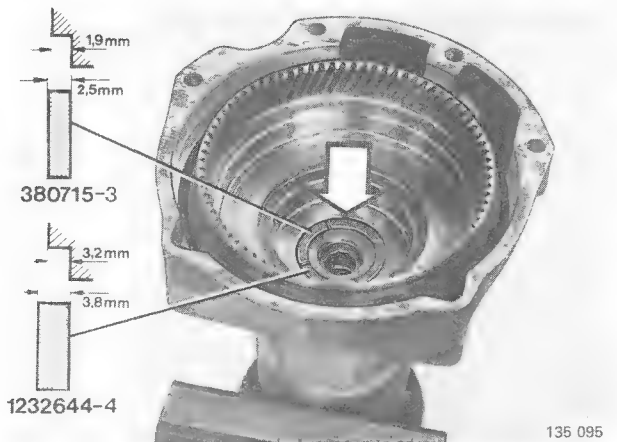
G5



**Tap oil seal into rear housing**

Use drift 5308.

*Type P: Proceed to operation G13.*



*Operations G6 to G12 only refer to Type J.*

*Before installing one-way clutch:*

G6

**Make sure thrust washer is correctly positioned**

If thrust washer is replaced, make sure that it is correctly positioned. It should be 0.6 mm (0.024 in) above edge.

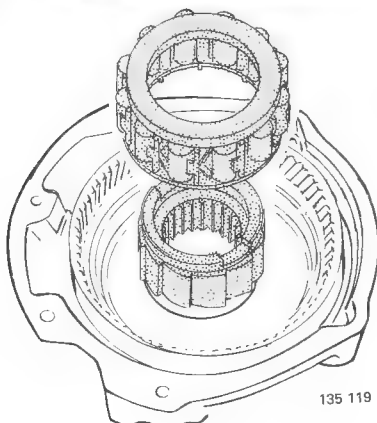
G7

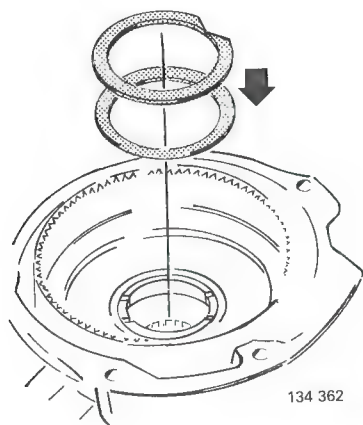
**Correct thrust washers:**

- Use thickness 2.5 mm (0.1 in), P/N 380 715-3, for early version of output shaft, P/N 380 679-1 and P/N 1 232 105-5.
- Use thickness 3.8 mm (0.15 in), P/N 1 232 644-4, for output shaft P/N 1 232 646-3.

G8

**Install one-way clutch hub and roller cage with rollers**

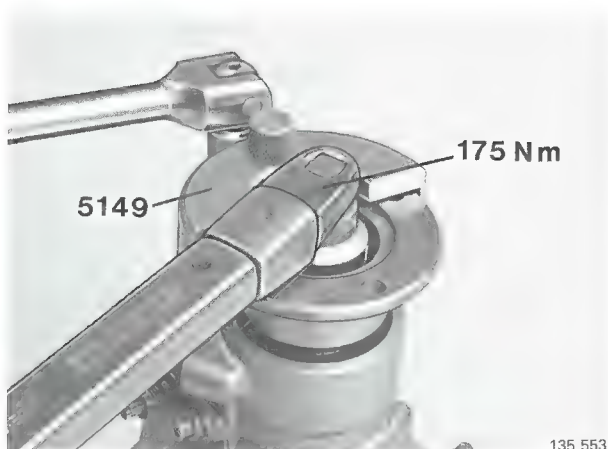




G9

### Install oil slinger and lock ring

Check that one-way clutch functions correctly.



G10

### Install drive flange

Apply locking fluid, P/N 1 161 075-5, to splines. Be careful not to apply to seal.

Use press tool 1845 if required.

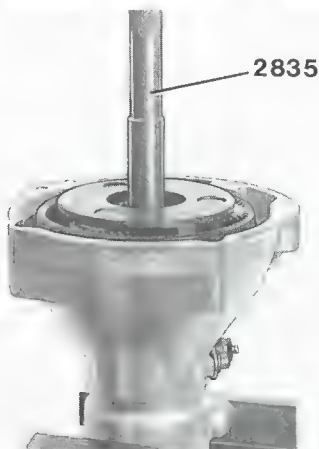
G11

### Install nut

Round drive flange: use wrench 5149.

Three-arm drive flange: clamp drive flange in a vice.

Torque to 175 Nm (130 ft lb).

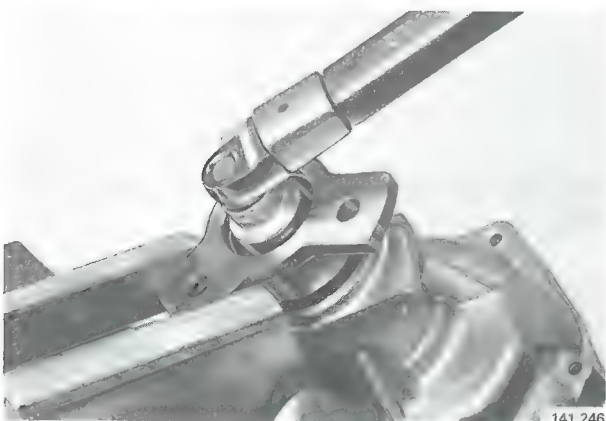


G12

### Install planetary gear on output shaft

Guide splines into carrier and one-way clutch hub. Use centering drift 2835.

Proceed to operation G 18.



Operations G13 to G17 only apply to Type P.

G13

### Install drive flange

Apply locking compound, P/N 1 161 075-5, to splines. Be careful not to apply to seal. Use press tool 1845 if required.

G14

### Install nut

Round drive flange: use wrench 5149.

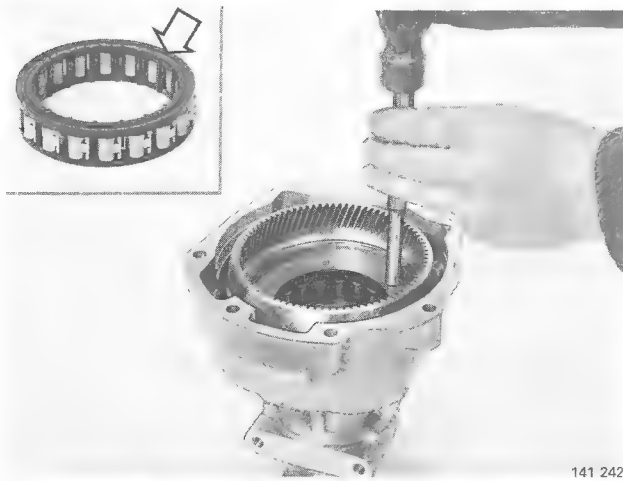
Three-arm drive flange: clamp drive flange in a vice. Torque to 175 Nm (130 ft lb).

G15

**Position roller cage for one-way clutch**

Groove on roller cage should face UP.

Use a drift to tap in oil slinger.



141 242

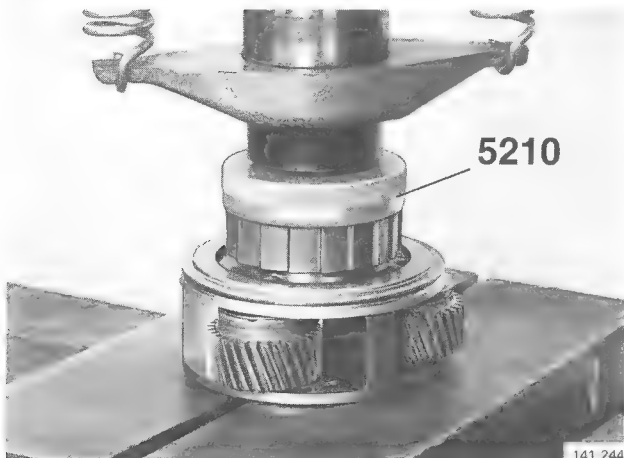
G16

**Press one-way clutch hub on to planetary gear carrier**

Wipe off splines.

Bevelled edge on hub should face DOWN.

Use ring **5210** when pressing.



141 244

G17

**Install:**

- brass thrust washer
- planetary gear carrier



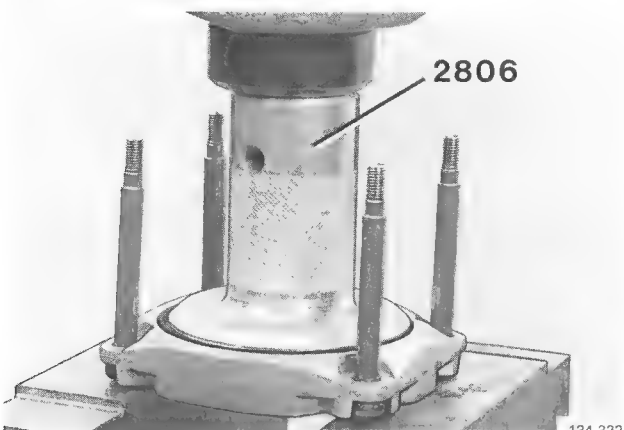
141 259

**Installing clutch assembly**

G18

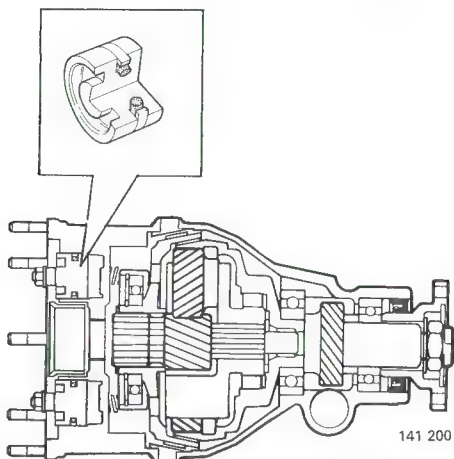
**Press in bearing**

Use drift **2806**. Attach lock ring



134 322

**Type P: Proceed to operation G 21.**



**Operations G 19 to G 21 only apply to Type J.**

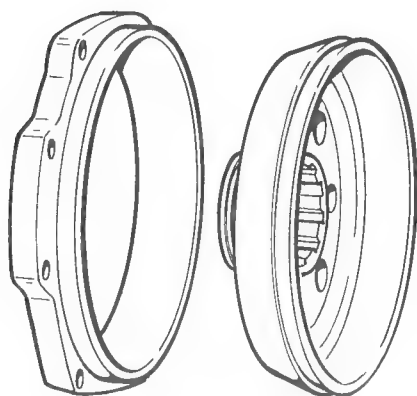
**G19**

**Asbestos-free clutch linings in overdrive Type J for D 24 T**

From transmission serial number 1 208 438/107 770, the D24 T is equipped with asbestos-free linings in the overdrive. However, there are some D 24 T models with higher transmission serial numbers which have the old type friction linings, see below.

Engine	Transmission serial number	Overdrive Volvo P/N	Laycock Overdrive No	
D24T	1 208 438/107 770-108 305	1 208 478	115 970	With asbestos-free clutch linings
D24T	1 208 438/108 306-	1 208 478 or	115 970	With asbestos-free clutch linings
		1 208 282	115 925	With old type clutch linings

The asbestos-free material has improved friction properties, which make it possible to reduce overdrive oil pressure to 2.8–3.1 MPa (400–440 psi). The new clutch linings also have a larger area.



**380 910-0**

**1377039-1**

141 604

**G20**

**When overhauling**

For Turbo vehicles, clutch linings of the asbestos-free type (P/N 1 377 039-1) should be used, unless already used as shown in chart above.

When replacing clutch linings, the brake drum should also be replaced. P/N 380 910-0.

(All Type P overdrives have asbestos-free clutch linings.)



G21

**Dry clutch in a warm place**

All moisture must be removed from the friction lining before the clutch is fitted to the front housing. When dry, oil lining with ATF type F or G.

G22

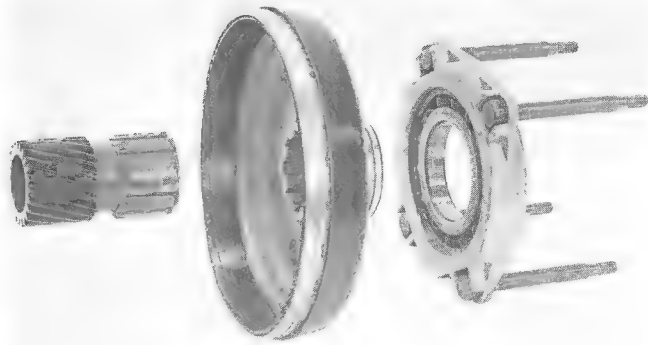
**Install:**

- sun gear
- clutch
- lock rings.

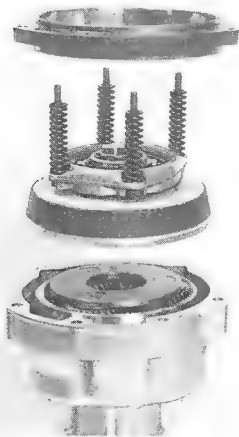
G23

**Install:**

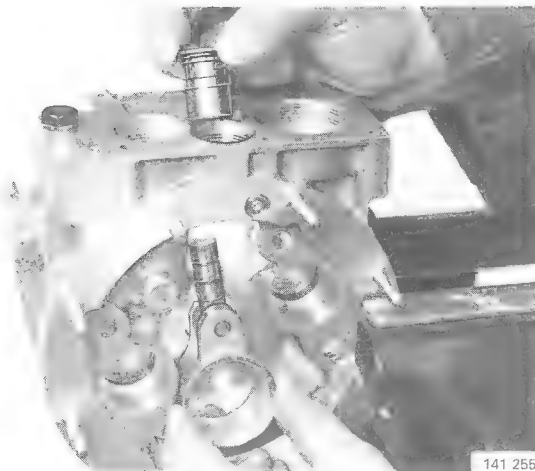
- clutch assembly
- springs
- gasket between rear housing and brake drum. Make sure gasket is installed correctly.
- brake drum



134 331



141 260



141 255

**Assembling front housing**

*Prior to assembling, make sure front housing is carefully cleaned. The hydraulic system is very sensitive to dirt.*

G24

**Lubricate oil pump with ATF before fitting to front housing**

Make sure that the groove and bevel on the pump plunger are aligned with the recess for the pressure filter. This prevents knocking noise from pump.

G25

**Check non return valve seat for leakage**

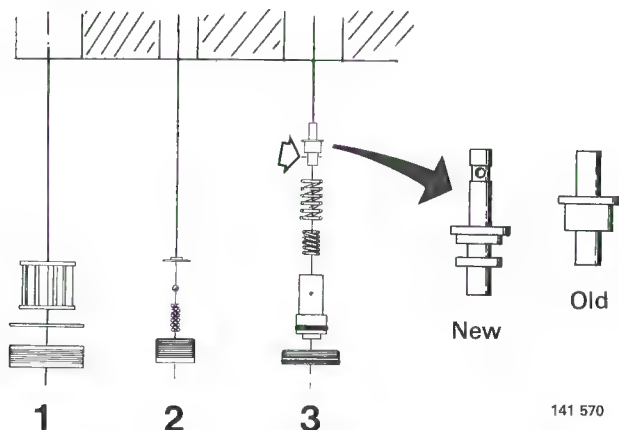
Blow through the valve to check for leakage. If the leakage is slight place the seat and steel ball on a flat surface and tap the ball with a plastic mallet. Recheck.

If the leakage is large the valve seat is probably too oval and therefore should be replaced. Make sure when fitting the valve that the steel ball is positioned correctly.



135 121

G26



#### Install:

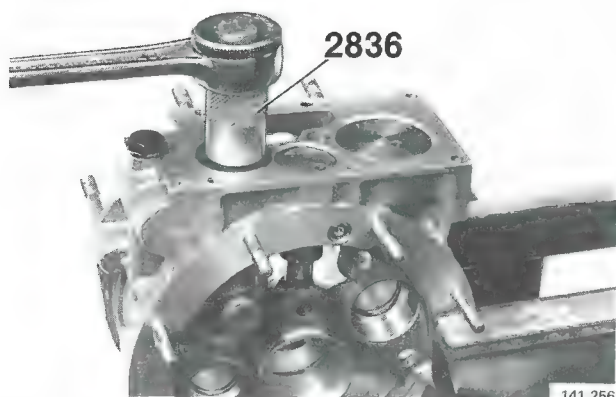
1. Oil filter, gasket and plug.
2. Seat, ball, spring and plug for check valve. Make sure ball is positioned correctly.
3. Relief valve parts. Always use new type if piston is replaced. Install shims, if applicable.

**Note:** If new clutch linings of asbestos-free type have been installed, no shims should be fitted to the relief valve.

G27

#### Torque plugs

Use plug wrench **2836** and torque to **22 Nm (16 ft lb)**.



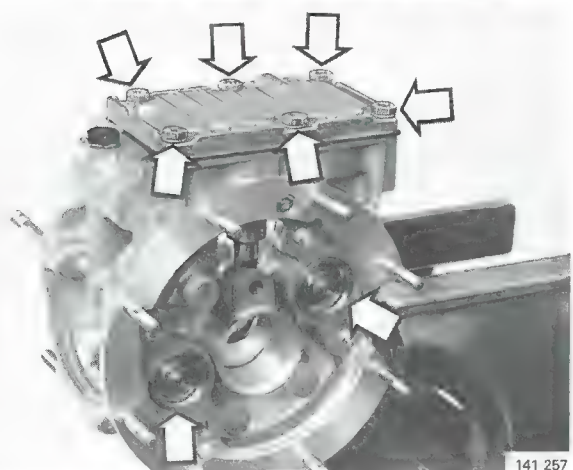
G28

#### Install oil pan

Install strainer and gasket.

Make sure magnet in oil pan is cleaned.

Torque bolts to 10 Nm (7 ft lb).



G29

#### Position clutch pistons in cylinders

**Note:** As a running modification during the Spring of 1985, 4 mm longer clutch pistons with a Teflon ring on the outside of the O-ring for improved sealing, have been installed. Pistons with O-rings should be replaced by new type pistons with Teflon ring, P/N 1 377 041-7.

G29

#### Assemble rear and front housings

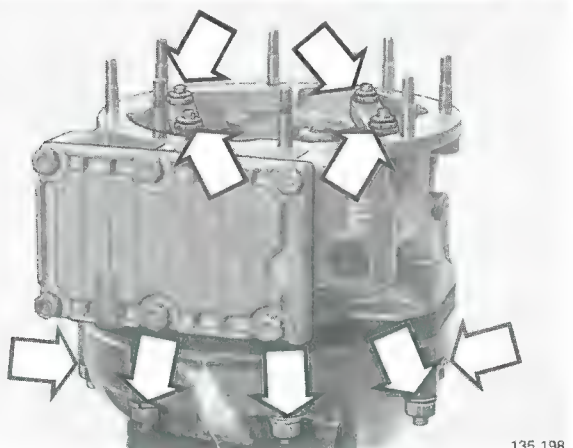
**Note:** Make sure gasket fitted between brake drum and rear housing is installed.

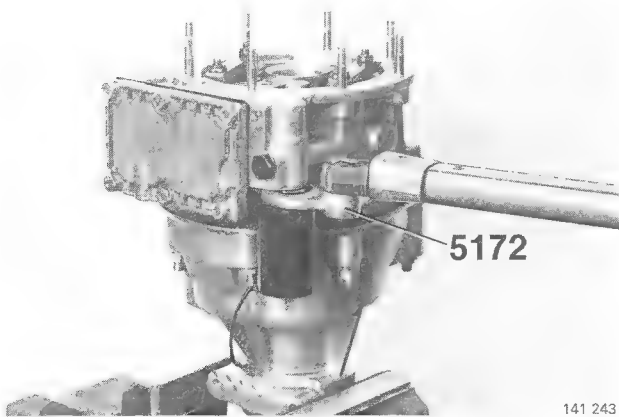
Remove remains of old nylon washers from two upper bolts on rear housing. Install new nylon washers, small end towards rear housing. Torque nuts in stages to 12 Nm (9 ft lb).

G30

#### Install bridges

Torque nuts to 10 Nm (7 ft lb).



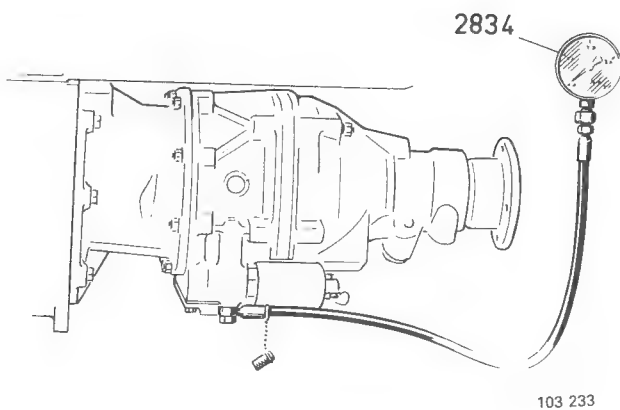
**Install solenoid. Attach ground wire.**

Use crow-foot wrench **5172**.

Torque to 50 Nm (37 ft lb).

## H. Testing oil pressure

*Special tool: 2834*



The oil pressure can be checked when driving on test rollers or highway.

Remove plug or switch below control valve and connect test gauge **2834**.

Drive in 4th gear, overdrive disengaged, speed 70 km/h (45 mph). Pressure should be approx. 0.15 MPa (21 psi).

Engage overdrive. Pressure should increase to:

**Type J**

D24T and gasoline Turbo	<b>Rebuilt</b> with asbestos-free clutch linings	<b>3.1–3.4 MPa</b> (440–483 psi)
----------------------------------	--	-------------------------------------

D24T	<b>Originally</b> with asbestos-free clutch linings (overdrive P/N 115 970)	<b>2.8–3.1 MPa</b> (400–440 psi)
------	---	-------------------------------------

Gasoline Turbo	With <b>old type</b> clutch linings	<b>3.9–4.2 MPa</b> (554–596 psi)
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Re- maining	With old type clutch linings	<b>3.7–4.0 MPa</b> (525–568 psi)
----------------	---------------------------------	-------------------------------------

**Type P**

All		<b>2.8–3.1 MPa</b> (400–440 psi)
-----	--	-------------------------------------

Disengage overdrive and check time for pressure reduction to 0.15 MPa (21 psi).

Time must not exceed 3 seconds.

M 46 Transmission components

- 1 Needle bearing  
2 2nd gear wheel  
3 Synchronizer ring  
4 Spring  
5 Operating sleeve  
6 Synchronizer hub  
6a Washer  
7 Sliding key ("dog")  
8 Synchronizer ring  
9 Lock ring  
10 1st gear wheel  
11 Damper  
12 Spring  
13 Brake cone  
14 Drive flange  
15 Needle bearing  
16 Thrust washer (if not equipped with damper)  
17 Sleeve  
18 Input shaft  
19 Needle bearing  
20 Lock ring  
21 Synchronizer ring  
22 Spring  
23 Operating sleeve  
24 Synchronizer hub  
25 Sliding key  
26 Synchronizer ring  
27 3rd gear wheel  
28 Needle bearing  
29 Main shaft  
30 Lock ring  
31 Intermediate shaft ("countershaft")  
32 Reverse gear wheel  
33 Stud shaft  
34 Overdrive switch  
35 Transmission (top) cover  
36 Gasket  
37 Spring  
38 Selector plate  
39 Pin  
40 Engaging lug  
41 Shift fork  
42 Gear selector  
43 Washer  
44 Guide pin  
45 Spring  
46 Lock ring  
47 Reverse gear selector  
48 Selector shaft

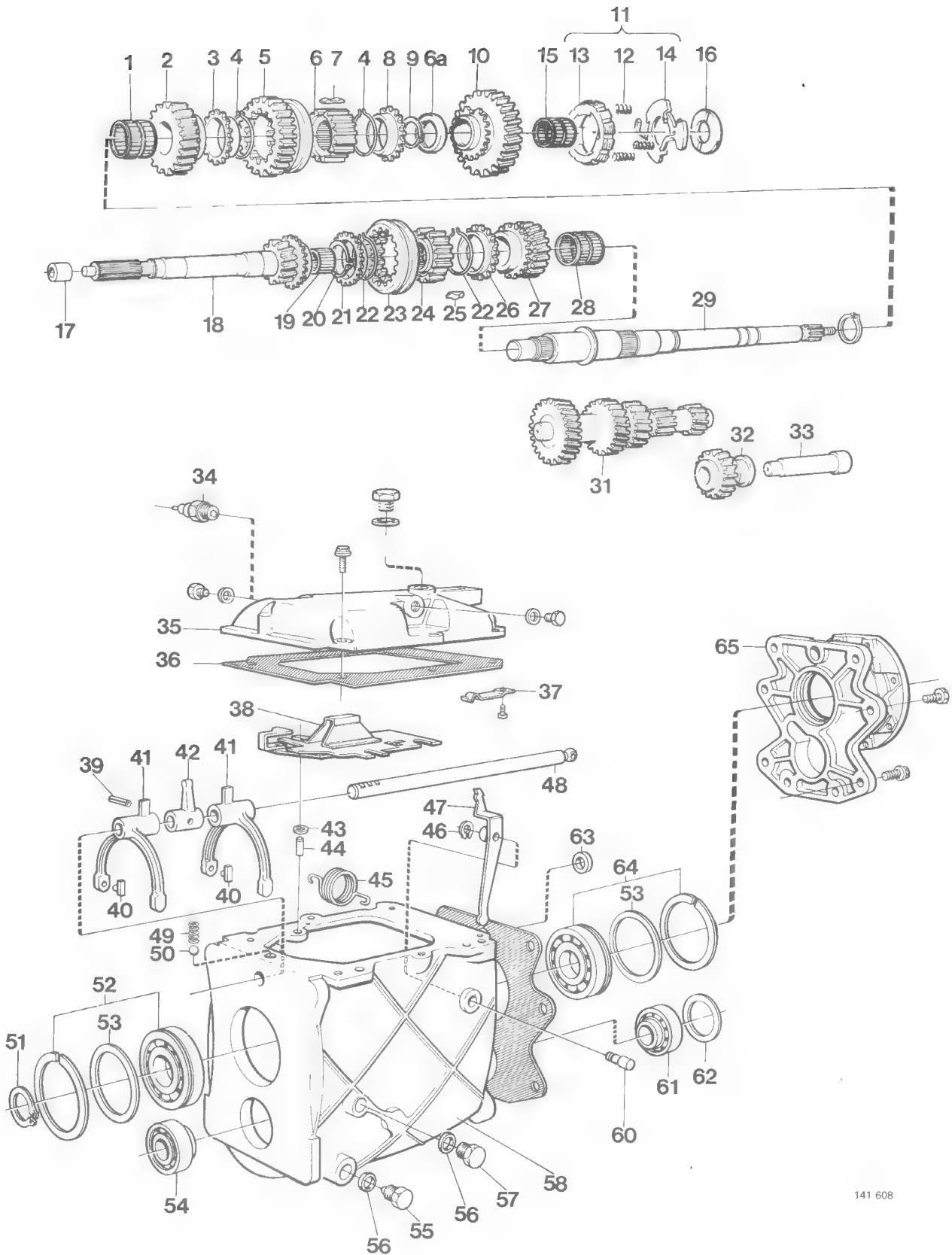
- 49 Spring  
50 Interlocking ball  
51 Lock ring  
52 Ball bearing  
53 Shim, thicknesses

P/N	mm	in
3292838-4	0.25	0.010
948008-8	0.60	0.024
948009-6	0.75	0.030
948010-4	0.90	0.036
948011-2	1.00	0.040

- 54 Roller bearing  
55 Magnetic debris plug  
56 Gasket  
57 Plug  
58 Transmission housing  
59 Gasket  
60 Stud shaft  
61 Roller bearing  
62 Shim, thicknesses

P/N	mm	in
949048-3	0.05	0.002
948298-5	0.10	0.004
948299-3	0.15	0.006
948300-9	0.35	0.014
948301-7	0.50	0.020
948302-5	0.70	0.028
948303-3	1.00	0.040

- 63 Seal  
64 Ball bearing  
65 Intermediate housing





M 47 Transmission components

- 1 Rear end cover  
2 Seal  
3 Top cover  
4 Gasket  
5 Spring  
6 Selector plate  
7 5th gear housing  
8 Gasket  
9 Roller bearing  
10 Bearing outer race  
11 Speedometer drive gear  
12 Bearing outer race  
13 Bearing inner race  
14 Shim, thicknesses:

P/N	mm	in
3294334-2	0.10	0.004
3294335-9	0.15	0.006
3294336-7	0.25	0.010
3204069-3	0.55	0.022
3204070-1	0.75	0.030

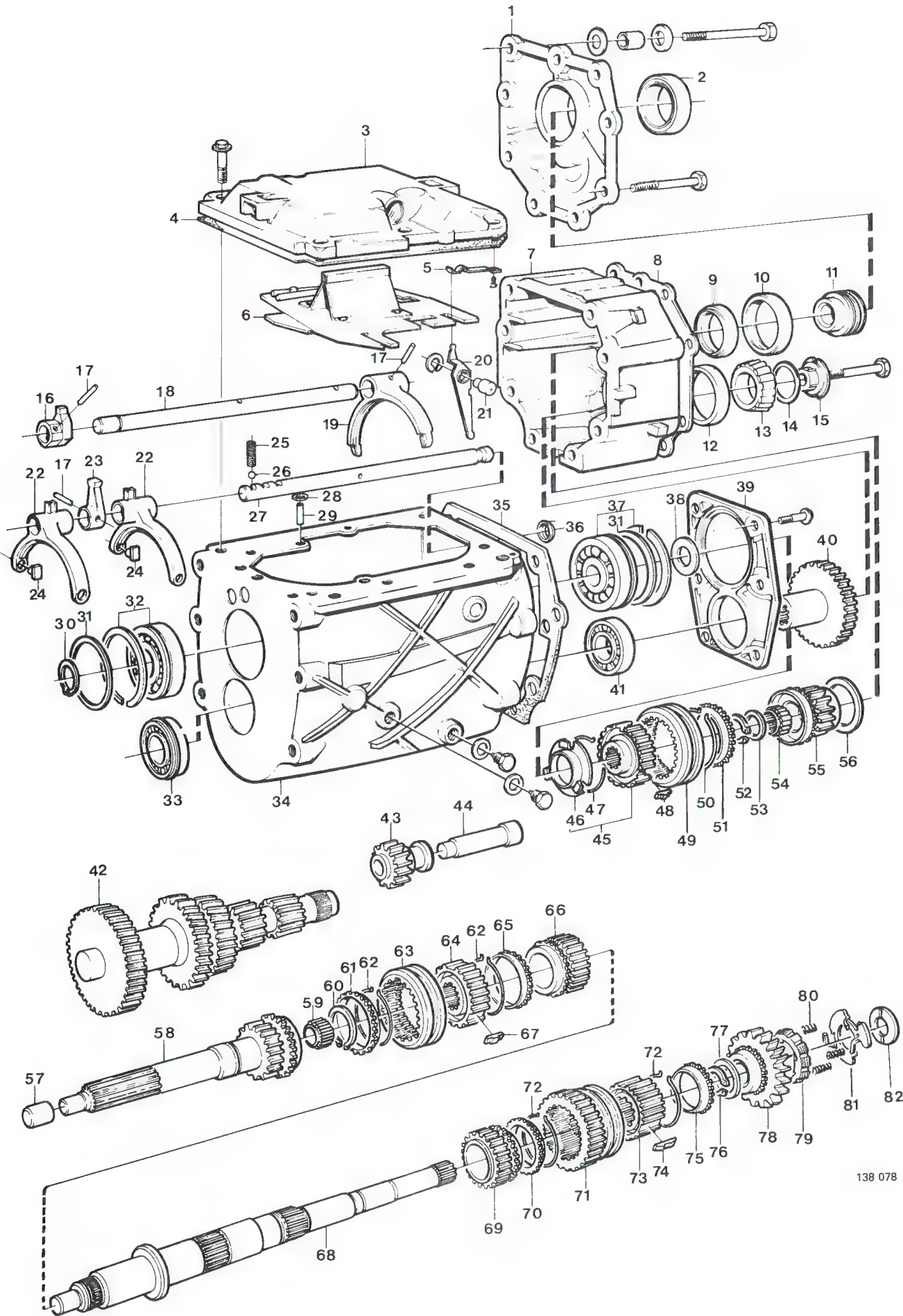
- 15 Washer  
16 Gear selector  
17 Pin  
18 Selector shaft  
19 Shift fork  
20 Reverse gear selector  
21 Stud shaft  
22 Shift fork  
23 Gear selector  
24 Engaging lug  
25 Spring  
26 Interlocking ball  
27 Selector shaft  
28 Sliding washer  
29 Guide pin  
30 Lock ring  
31 Shim, thicknesses:

P/N	mm	in
3292838-4	0.25	0.010
948008-4	0.60	0.024
948009-6	0.75	0.030
948010-4	0.90	0.036
948011-2	1.00	0.040

- 32 Ball bearing  
33 Roller bearing  
34 Transmission housing  
35 Gasket  
36 Seal  
37 Ball bearing  
38 Shim, thicknesses:

P/N	mm	in
34615-5	0.10	0.004
120116-9	0.15	0.006
34614-8	0.35	0.014
947120-2	0.50	0.020

- 39 Bearing holder  
40 Drive gear  
41 Roller bearing  
42 Intermediate shaft  
43 Reverse gear wheel  
44 Stud shaft  
45 Synchronizer hub  
46 Drive flange  
47 Spring  
48 Sliding key ("dog")  
49 Operating sleeve  
50 Spring  
51 Synchronizer ring  
52 Lock ring  
53 Spacer  
54 Needle bearing  
55 5th gear wheel  
56 Spacer  
57 Sleeve  
58 Input shaft  
59 Needle bearing  
60 Lock ring  
61 Synchronizer ring  
62 Spring  
63 Operating sleeve  
64 Synchronizer hub  
65 Synchronizer ring  
66 3rd gear wheel  
67 Sliding key  
68 Main shaft  
69 2nd gear wheel  
70 Synchronizer ring  
71 Operating sleeve  
72 Spring  
73 Synchronizer hub  
74 Sliding key  
75 Synchronizer ring  
76 Lock ring  
77 Washer  
78 1st gear wheel  
79 Damper cone  
80 Spring  
81 Drive flange  
82 Thrust washer (if not equipped with damper)



## M 47 II Transmission components

- 1 Rear end cover
- 2 Seal
- 3 Top cover
- 4 Gasket
- 5 Spring
- 6 Selector plate
- 7 Lock ring
- 8 Reverse gear selector
- 9 Stud shaft
- 10 5th gear wheel
- 11 Washer
- 12 Rear housing
- 13 Gasket
- 14 Bearing outer race
- 15 Roller bearing
- 16 Bearing inner race
- 17 Thrust washer
- 18 Bearing outer race
- 19 Bearing inner race
- 20 Shim, thicknesses:

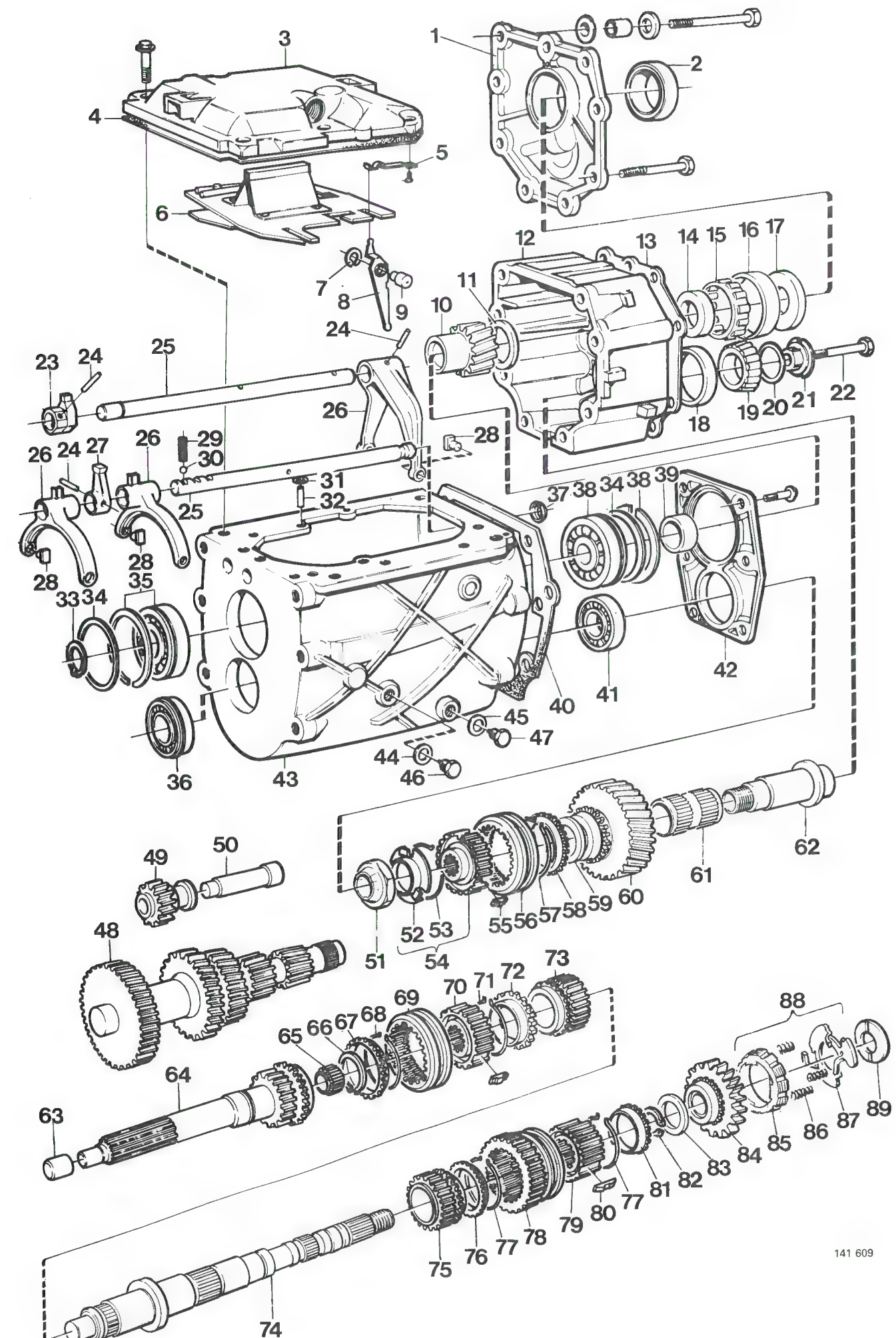
P/N	mm	in
3294334-2	0.10	0.004
3294335-9	0.15	0.006
3294336-7	0.25	0.010
3204069-3	0.55	0.022
3204070-1	0.75	0.030

- 21 Washer
- 22 Bolt
- 23 Gear selector
- 24 Pin
- 25 Selector shaft
- 26 Shift fork
- 27 Gear selector
- 28 Engaging lug
- 29 Spring
- 30 Interlocking ball
- 31 Washer
- 32 Guide pin
- 33 Lock ring
- 34 Shim, thicknesses:

P/N	mm	in
948008-8	0.60	0.024
948009-6	0.75	0.030
948010-4	0.90	0.036
948011-2	1.00	0.040

- 35 Ball bearing
- 36 Roller bearing
- 37 Seal
- 38 Ball bearing
- 39 Spacer

- 40 Gasket
- 41 Roller bearing
- 42 Bearing holder
- 43 Transmission housing
- 44 Gasket
- 45 Seal
- 46 Plug
- 47 Magnetic debris plug
- 48 Intermediate shaft
- 49 Reverse gear wheel
- 50 Stud shaft
- 51 Nut
- 52 Washer
- 53 Spring
- 54 Synchronizer ring
- 55 Sliding key ("dog")
- 56 Operating sleeve
- 57 Spring
- 58 Synchronizer ring
- 59 Washer
- 60 Gear wheel
- 61 Needle bearing
- 62 Shaft
- 63 Sleeve
- 64 Input shaft
- 65 Needle bearing
- 66 Lock ring
- 67 Synchronizer ring
- 68 Spring
- 69 Operating sleeve
- 70 Synchronizer hub
- 71 Spring
- 72 Synchronizer ring
- 73 3rd gear wheel
- 74 Main shaft
- 75 2nd gear wheel
- 76 Synchronizer ring
- 77 Spring
- 78 Operating sleeve
- 79 Synchronizer hub
- 80 Sliding key
- 81 Synchronizer ring
- 82 Lock ring
- 83 Washer
- 84 1st gear wheel
- 85 Brake cone
- 86 Spring
- 87 Drive flange
- 88 Damper
- 89 Thrust washer (if not equipped with damper)





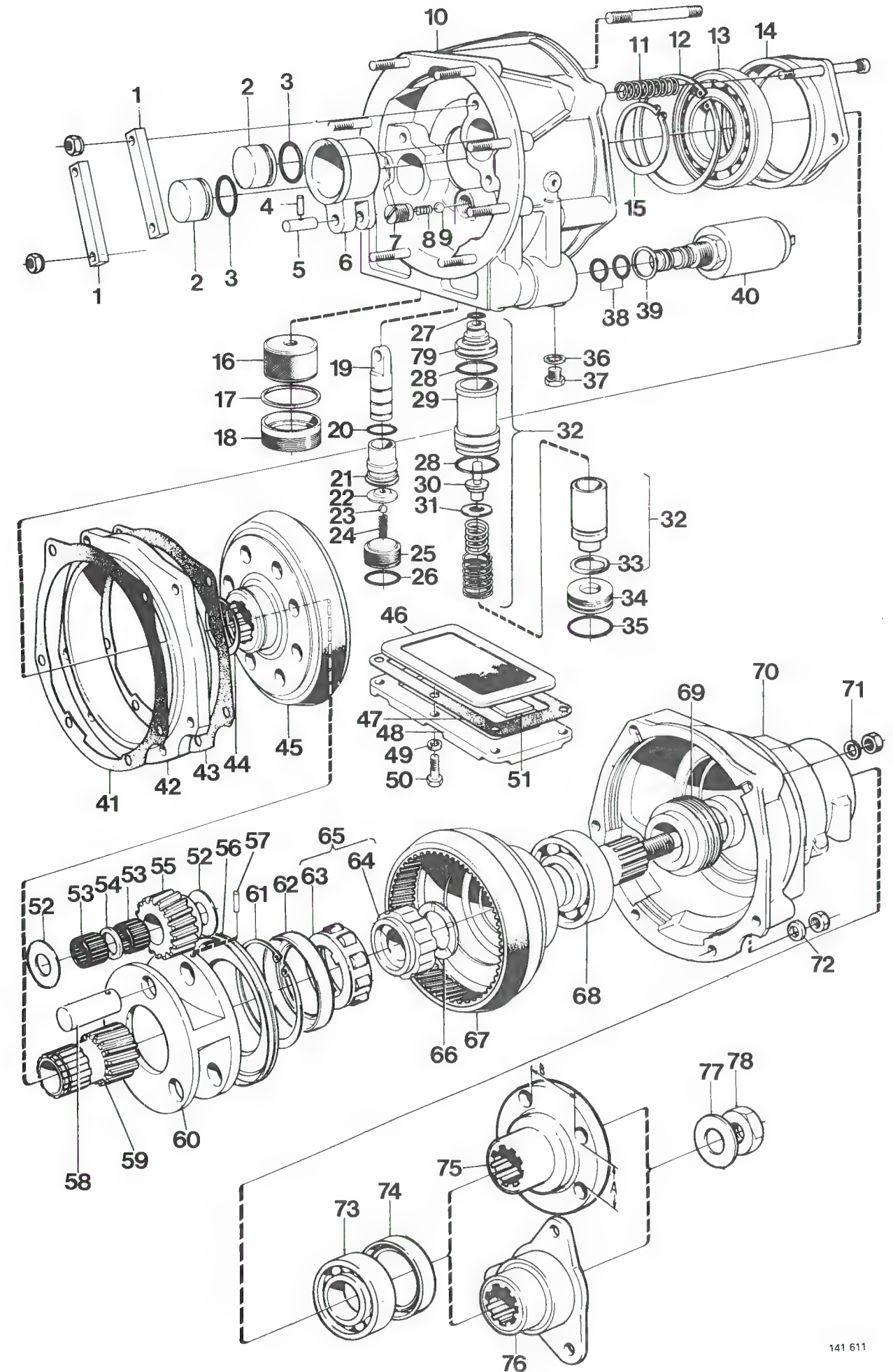
## Type J Overdrive components

- 1 Bridge
- 2 Clutch piston
- 3 O-ring
- 4 Pin
- 5 Guide pin
- 6 Pump link
- 7 Relief valve
- 8 Spring
- 9 Ball
- 10 Front housing
- 11 Spring
- 12 Lock ring
- 13 Clutch bearing
- 14 Bearing holder
- 15 Lock ring
- 16 Oil filter
- 17 Washer
- 18 Plug
- 19 Pump piston
- 20 O-ring
- 21 Pump cylinder
- 22 Seat
- 23 Ball
- 24 Spring
- 25 Plug
- 26 O-ring
- 27 O-ring
- 28 O-ring
- 29 Cylinder
- 30 Piston
- 31 Pressure adjusting shim, thicknesses:

P/N	mm	in
1209450-4	0.05	0.0020
1209451-2	0.13	0.0052
1209452-0	0.25	0.0100
1209453-8	0.76	0.0300

- 32 Relief valve assembly
- 33 O-ring
- 34 Plug
- 35 O-ring
- 36 Seal
- 37 Plug
- 38 O-ring
- 39 Seal
- 40 Solenoid valve
- 41 Gasket
- 42 Brake drum
- 43 Gasket
- 44 Lock ring
- 45 Clutch

- 46 Strainer
- 47 Gasket
- 48 Oil pan
- 49 Spring washer
- 50 Bolt
- 51 Debris magnet
- 52 Thrust washer
- 53 Needle bearing
- 54 Spacer washer
- 55 Planetary gear wheel
- 56 Oil slinger
- 57 Lock pin
- 58 Shaft
- 59 Sun gear
- 60 Planetary gear carrier
- 61 Lock ring
- 62 Race
- 63 Roller cage
- 64 One-way clutch hub
- 65 One-way clutch
- 66 Thrust washer
- 67 Output shaft
- 68 Ball bearing
- 69 Speedometer drive gear
- 70 Rear housing
- 71 Spring washer
- 72 Seal
- 73 Ball bearing
- 74 Seal
- 75 Drive flange, round
- 76 Drive flange, three-armed
- 77 Washer
- 78 Nut
- 79 Seat



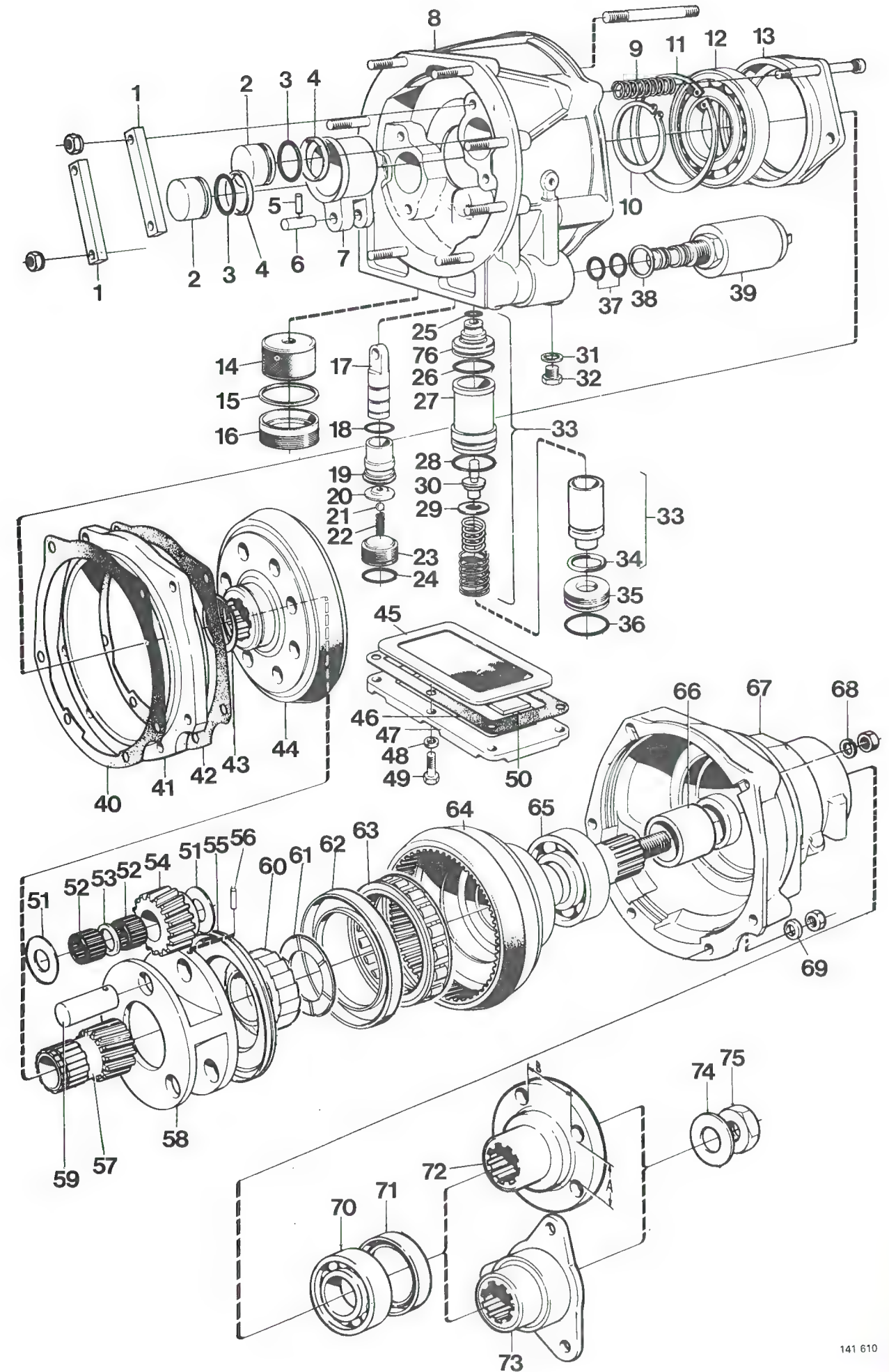
## Type P Overdrive components

- 1 Bridge
- 2 Clutch piston
- 3 O-ring
- 4 Teflon ring
- 5 Pin
- 6 Guide pin
- 7 Pump link
- 8 Front housing
- 9 Spring
- 10 Lock ring
- 11 Lock ring
- 12 Clutch bearing
- 13 Bearing holder
- 14 Oil filter
- 15 Washer
- 16 Plug
- 17 Pump piston
- 18 O-ring
- 19 Cylinder
- 20 Seat
- 21 Ball
- 22 Spring
- 23 Plug
- 24 O-ring
- 25 O-ring
- 26 O-ring
- 27 Cylinder
- 28 Pressure adjusting shim, thicknesses:

P/N	mm	in
1209450-4	0.05	0.0020
1209451-2	0.13	0.0052
1209452-0	0.25	0.0100
1209453-8	0.76	0.0300

- 30 Piston
- 31 Seal
- 32 Plug
- 33 Relief valve assembly
- 34 O-ring
- 35 Plug
- 36 O-ring
- 37 O-ring
- 38 Seal
- 39 Solenoid valve
- 40 Gasket
- 41 Brake drum
- 42 Gasket
- 43 Lock ring
- 44 Clutch

- 45 Strainer
- 46 Gasket
- 47 Oil pan
- 48 Spring washer
- 49 Bolt
- 50 Debris magnet
- 51 Thrust washer
- 52 Needle bearing
- 53 Spacer
- 54 Planetary gear wheel
- 55 Oil slinger
- 56 Locking pin
- 57 Sun gear
- 58 Planetary gear carrier
- 59 Shaft
- 60 One-way clutch hub
- 61 Thrust washer
- 62 Race
- 63 Roller cage
- 64 Output shaft
- 65 Ball bearing
- 66 Spacer
- 67 Rear housing
- 68 Spring washer
- 69 Seal
- 70 Ball bearing
- 71 Seal
- 72 Drive flange, round
- 73 Drive flange, three-armed
- 74 Washer
- 75 Nut
- 76 Seat





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# FEEDBACK

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